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A HANDBOOK OF PRACTICAL

TREATMENT

BY MANY WRITERS

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DISEASES OF THE CARDIOVASCULAR SYSTEM

By Sir Clifford Allbutt

The Principles of Cardiac Therapeutics

Introductory.—In the treatment of chronic heart disease in its broadest aspects, without regard to subordinate features which shall have their due consideration in their own places, there are certain principles applicable more or less to all of them, different though they be both as groups and as cases. At first sight it would seem that maxims so broad as to cover, let us say, acute cardiac disease, chronic valvular disease, and myocardial degeneration, must by their breadth be attenuated to films; and in delineating this case and that, we may wonder in the midst of the variety where principles or common measures are to be found. We shall be guided to them in part by the trend of modern therapeutics which, stooping to conquer and relinquishing grandiose pretentions to nostrums and specifics, is condescending to recognize the every-day dealings of nature with her kinds. Like Elisha, the modern prophet is seeking the sources of therapeutic success less in specifics than in the wholesome virtues of natural forces; in periods of systematic repose, in hygiene of waters, airs, and places, in diets, in regulated bodily exercises, and in other physical means. It is true of the heart, as of other organs, that many of its diseases are from without; many of them come of familiar errors and every-day abuses, they roost where they have had their home and birth, and, if curable, must be cured as they were bred. If there be a way out it is by the way of coming in. A little readjustment of mechanics, a little revision of common foods and habits, a shrewd estimate of the drift of symptoms; such homely methods, less imposing as they are than much that was more pretentious, are the basis of the medicine of the future; yet it will not be supposed that such methods are by any means independent of drugs, nor even of a few "specifics." A curious patient, taking strophanthus, discovered to his astonishment I was administering to him an arrow poison from the Gaboon! And in respect of drugs also, we are trying to discover, to interpret, and to apply them on mechanical, chemic, and biologic principles. While we are far from denying that much of medicine must still be

empiric, that we have lighted by chance on means of relief which we can spare as little as we can explain, yet we are learning also that in the main certain physical, physiologic, and hygienic laws regulate cardiac disease as they do pulmonary tuberculosis; and nowadays we think no more of curing heart disease than we do of curing phthisis, by a prescription. Senac said that the farther we investigated diseases of the heart the more sterile did medicine appear; What, for instance, can we expect of drugs in dilatations of the heart? Balfour's comment on this is: "To this doleful query modern medicine has given a triumphant reply."

The most important of the mechanical laws of the circulation have been formulated of late years by the researches of modern physiologists, who have applied to the work of the heart and circulation those laws of physics by which our systematic study of heart diseases must be governed, if not completed. If, as far as the state of our knowledge permits, we comprehend these laws, we shall not only treat heart diseases more intelligently, but even in the technical applications of pharmacy we shall be enabled to use our drugs with more definite purpose and efficiency. For instance, in defect of the results of modern pharmacologic research Withering and Fothergill could use digitalis only empirically, that is, in a more or less groping way; now this herb is a weapon of precision, and its properties are so industriously investigated that we can work with it, alone or in combination with other agents, if not with complete command of its resources, at any rate with no little address; for in it we have a quasimechanical agent, a potent means of raising blood-pressure in the arterial system, and thus of preventing that large coefficient of death, the slipping away of the blood from the arteries into the veins.

On another side of the treatment of heart diseases, by the labor of physiologic chemists we have learned how great a part in their causation and aggravation is played by the disorders of digestion and nutrition. We have not only learned much of the laws of general nutrition, but we have ascertained a good deal also concerning that of the heart itself. We have learned, for example, that growth depends on use, and that in practice, so long as it is duly fed, there is no close limit to the static increase of any part the functions of which are enlarged; the due feeding of it being, of course, dependent not only on the provision of food but also upon the capacities of its channels of supply and on the avidity of its tissues. A closer knowledge of the mechanics of blood-pressure and of the means of modifying it, together with a knowledge of the best means of reinforcing the heart, enables us to compass rearrangements whereby under grave disadvantages the stability of the organ is restored or supported. Whatever then may be the site or origin of heart disease, we have to see that by regulation of venous and arterial blood-pressures certain increments of cardiomotive energy and certain redistributions of blood are established; and that during the readjustment the heart is nursed and fed. Thus it is manifest that the treatment of circulatory diseases must, for the most part, be considered

not only in departments but also as a whole. The peripheral functions must be considered as well as the cardiac. The principles are the same throughout, though in the variety of morbid incidents which may befall the heart and vessels in the manifold paths of strain, of injury, of poisons intrinsic and extrinsic, or in decay due to local or general causes, they receive various illustration. In the design of this work, therefore, a careful preliminary survey of the causes and processes concerned precedes the application of their principles to therapeutics.

Unlike an arm or leg, the heart cannot be put to rest; we may manage its functions, we cannot suspend them. To manage its work by bodily repose; repose as complete as circumstances may permit, is an old practice. Thus to put cardiac patients to bed for a time, and thereafter to restrain the exercise of the body within more or less narrow limits, seems not only imperative, but inevitable. Such treatment has gained the greater vogue because it answers so well in hospital practice, wherein usually are found the patients who have been starved, fagged, and hard put to it. Moreover, our forefathers did not become aware of disease of the heart until the patient was too far advanced to receive benefit from gradual solicitation of any reserve capacity; and for advanced cases rest and good nursing must be imperative. But, however apparently imperative and universal, the insight of Stokes perceived that this rule needed much modification. In hopeful cases, as we shall see hereafter, to make the heart a permanent invalid is as bad a general rule as permanently to invalid the body. Surgeons are learning more and more definitely that to lay up even a fractured limb, save for a short time in a few extreme cases, is bad practice. Stokes, however, did not succeed in impressing this part of his teaching upon his contemporaries, indeed, he did not himself see the full bearing of his still rather partial arguments. Besides, physicians, then coming under the excitement of the new revelations of the stethoscope, were not in a mind to heed him. Heart disease was still for them the broad road of death; heart disease was heart failure, hypertrophy was a disease, and every murmur a passing bell. And indeed it would seem too at first sight that the defective heart would always have enough to do to skirt the borders of failure; that, if in time of arrears complete rest were given to the body, and the heart relieved by taking off all incidental labor, the organ itself in its necessary work would find exercise enough; that surely there would be no need for the physician to impose work upon it, or to increase arterial pressure by drugs or exercises. Nevertheless, some contrary arguments slowly made way, and had so crept, almost imperceptibly, into consideration that we were not unprepared for the rousing if somewhat violent maneuvers of Oertel. The manner in which Oertel at first prescribed hill work to his patients, or how Zander and August Schott prescribed more artificial gymnastics, is, save as a matter of history, of secondary importance; now we are all agreed that, whatever nicety may be required in working out the comparative values of the means themselves, in heart disease the rule of continuous bodily repose needs large modifica-

tions. It follows then that we have to reckon moments and periods as well as abstract values. If a mere sparing the heart, whether by negative means or positive, is not always so successful a method as would seem likely, we shall have to use the most careful discrimination to decide at what stages of a heart disease rest is required, at what stages exercise. So too, in respect of digitalis, many physicians, while recognizing with gratitude the efficiency of the aid of the herb, feel even yet some grudge against it for its influence in increasing the tone of the muscular arteries and therewith the call upon the heart's reaction; and endeavor either to supplant it by some such agent as strophanthus, which may reinforce the heart with less peripheral constriction, or by a combination with vasodilators to abate peripheral tone while reinforcing cardiac energy. To this problem we shall return presently (p. 23); as we analyze a little more deeply the therapeutic intention of piling more work upon an organ already faltering under disadvantages often mainly, or even merely, mechanical, and consider when such solicitations of such a heart may be good for it, and how far such practices may be contrary to the doctrine of rest, or in some subtle way be rest in disguise. If it be the business of the heart to achieve the maximum of blood distribution with the minimum of disturbance of pressures, we may conceive, conversely, that if by gently arousing the heart we can distribute the blood more uniformly, it may thereby be more relieved by the abatement of its arrears than vexed by a prudent solicitation of its flagging energies.

Furthermore, it is by no means certain that every increase of arterial blood-pressure means an increase of work to the whole heart. Dominant as is the heart in the maintenance of the circulation, it is not the only machinery by which the circulation is forwarded. Certainly the converse—that every fall in pressure is a relief to the heart—is far from true. For instance, a rise in arterial pressure promotes the circulation of more and better blood in the walls of its own chambers and nervous centers; a fall implies the contrary. The heart and its nerves work in proportion to the rate of their wages. Besides, a rise in arterial pressure promotes diuresis, and is not inconsistent with a fall, general or local, in the volume of the blood; and by reduction of blood mass the work of the heart is directly alleviated. Whether a rise in peripheral resistance can be beneficial to a laboring heart is then a matter of particular calculation; it is certain that an increase in the mass of the circulating blood, whether relative or positive, means a dilating stress on the ventricles; and, the power being constant, with increase of diameter of these chambers the effective power falls in geometric proportion. When in disorders of the circulation we discover an unequal distribution of the blood in the body, and a corresponding loss of the balance of pressures, we must do all we can, even for the moment perhaps by compulsion of the heart itself, to shift the blood into a better distribution, to divide its volumes better among its spaces, and to restore the balance of pressures toward equilibrium. We do not suppose that even in health the carriage of the blood, under what-

soever normal economy of pressures, can be effected without considerable fluctuations of their balance; nor preserved without considerable variations of energy. The equilibrium of rest is the equilibrium of death. The circulation is a moving equilibrium, such as the swing of a pendulum, or, as Harvey conceived it, the perennial sweep of the celestial bodies; we more humbly may regard the circulation as a reciprocating engine, incessantly revolving about an ideal center, but spending its work not on an external but on an internal resistance. In its throw, or systole, energy is manifested in a difference of 30 to 40 mm. of mercury above its recoil, or diastole. Not only so, but as, if a marine engine were designed to cope only with smooth water the ship would suffer in a storm, so in the heart there must be a considerable reserve of energy whereby to meet the emergencies when the pressures are largely increased. The heart which works tranquilly while we are quietly engaged, on a sudden emergency can speed up to meet even an enormous demand. It is no rare emergency which calls upon it for an increase of pressure of 25 per cent. Plesch calculates that a contraction volume of 59 c.cm. may increase in hard work to 240; and that the blood may complete its circuit in five seconds. If such increases could not be met out of the reserves, and if these in the heart, as in many other of our organs, were not very large, we should not be here to discuss them; now even in the diseased heart we may have not infrequently to draw upon such reserves. Equilibrium is fleeting, stability must be inviolable.

Again, stresses so great as these could not be long continued were it not for certain compensatory mechanisms, mainly under the control of the nervous system. The normal arterial pulse is a function of many variables, and one of our great difficulties in the treatment of cardio-arterial disease is our ignorance of the precise reciprocations of these nervovascular mechanisms. If the heart moves the blood, the arteries distribute it. In some cases we have good reason to suppose the nervous factor to be gravely concerned; as, for example, in neuritis of the vagus in such a disease as influenza, or in the troublesome but more or less amenable and transient storms which checker the course of chronic valvular disease. But in many other conditions of arrhythmia of the heart, in the presence perhaps of infectious or other poisons, or in elderly patients, we find an almost insuperable difficulty in deciding how far the disordered function is a result of defect or disturbance seated in the nervous apparatus, or by its means propagated from some peripheral irritation, or again how far it lies in the proper structure of the heart itself. We may have to deal with a disease of the nervous structures; or with a reflex irritation of the nerves from some distant focus; or with some direct lesion of the cardiac muscle; or with combinations and permutations of these factors. And yet, from the point of view of treatment, to discriminate between these several conditions, and in case of the coöperation of two or more of them, to distribute to each its due value must be a very important element in our success. Fortunately, in cases as difficult as these, we

shall be aided in our search for some definite line of treatment by a preciser estimation of the relative pressures in the various areas of the circulation, especially in the broad contrast of the arterial and the venous; so that by modifying these pressures with such means as we possess we may make at least a partial readjustment. At any rate, wherever the primary causes of the disturbance of the circulation may arise, it will be inept to goad the heart itself to further efforts while its burdens are awry and their weights badly distributed. Before making more sail, we shall do our best to trim the boat by shifting the cargo and even throwing some of the cargo overboard.

In diagnosis we have been too ready to betake ourselves at once to the stethoscope; we do better when we estimate all that is to be gathered by sight, touch, and history before we avail ourselves of the supplements of the ear. For instance, in a circulation which is as yet mechanically sound the passage of the blood through the periphery may be hindered, and the arterial blood heaped up in the arterial channels; in this case the heart must dilate to hold more blood, and its efforts to get the blood forward must be greatly increased. In such cases as these, when we find the velocity of the blood-stream falling and the arterial pressure rising, to interfere with the abnormal efforts of the heart without some redistribution of blood-pressures may do more harm than good. This redistribution our fathers used to attempt to make, and often did promptly by venesection; and in this way, moreover, the blow of many an apoplexy was warded off.

The apparent contradiction of prescribing work for the relief of fatigue is in part to be explained by the phenomena of muscular loading. A muscle does not contract most efficiently when free, but when, within limits, it is loaded; and there is a certain load which for a given muscle conditions its maximum efficiency. If then it is true that an overload may be so great as to oppress the right or left ventricle to the limits of endurance, yet, on the other hand, as for its full efficiency the normal mean is required, in not a few cases we have to try to restore energy to one or other or to both sides of the heart by supplying blood in quantity approximate to the normal contraction volume of the respective chambers, when, if it has not undergone intrinsic decay, the heart, or the underloaded part of it, should gain rather than lose efficiency. In some modes of disorder the left side or the right side of the heart may be overloaded, while in others it is by underloading that the contraction of this chamber or that, or of more than one, is ineffectual. Collapse is the simplest of these cases, and appears to us in a dramatic form; but underloading of the heart, or of a part of it, is a frequent if less obvious factor in chronic disease: in pure mitral stenosis, for example, the charge of the left ventricle falls short, and its contractions fall accordingly in value; while those of the right chambers, on the contrary, are impeded by overloads which these chambers cannot efficiently discharge. We may now appreciate that compound effect of digitalis whereby it may further the work of the left side of the heart remarkably,

not by diminishing the resistance, not only by direct stimulation of the muscle, but also by a contraction of peripheral vessels which for the moment positively increases its load. Thus the attempt, on which we have touched, to defeat this provision by combining digitalis with vasodilator drugs, if the combination may perhaps have its occasional use, is, in many cases at any rate, as false in theory as it is erroneous in practice. In collapse, shock, and certain syncopes with underloading of the heart, we shall not in the first instance be content to stir up the heart directly to greater effort, but we shall endeavor to compass our ends indirectly also, or perhaps at first indirectly only, by artificial respiration, by the recumbent posture, by compression of the abdomen, or even by the injection of fluids into the circulation and the administration of such drugs as ergot or adrenalin. In the various cases of low arterial pressure due to relaxation of the splanchnic vessels the languid contractions of the heart may be surprisingly reinforced by laying the patient flat upon the floor, and so pouring blood from them into the underloaded chambers of the heart, as well as into the cerebral and bulbar arteries. In mitral disease with high pressures on the venous side and a static accumulation in the pulmonary, abdominal, and other dependent areas, if the right heart is overloaded the left is often underloaded; and we should avoid the too common error of driving the whole heart to stronger and stronger efforts before we have done something to restore areas of pressure as far as possible toward a normal distribution: to restore, that is, a proper balance between arterial and venous contents, and to readjust the respective ventricular loads. In aortic stenosis or arterial hyperpiesis, on the other hand—in the earlier stages, that is, before the accumulation of stresses begins to tell more and more backward—it is the right ventricle which may be temporarily underloaded; but, as the vessels of the lungs are passive, high pressure in the left ventricle is virtually high pressure in both auricles. When, however, in such cases as Addison's disease or myxedema, the pressure in the left ventricle and arterial tree is below normal, as the heart may be doing all that the slow rate of general function demands, and is itself ill nourished, it may not be advisable to urge it at once to more vigorous efforts. In aortic regurgitation the ordinary disturbance to be mitigated is not so much a static heaping up of pressures in this or that area as a rocking of pressures between abnormally separated extremes.

Acute Cardiac Disease

It is not, I think, to stretch our knowledge too far to say that endocarditis and pericarditis, with the certain but rare exception of cases due to injury to the chest-wall, such as contusion without wound or fracture (cases obviously surgical which are here excluded), and with the doubtful exception of Bright's disease, almost always arise in an infection; commonly, at any rate, of bacterial origin. The experiments of Paine and Poynton have brought the identification of a rheumatic

microbe almost to the degree of conviction, and acute rheumatism accounts for by far the largest number of cases of endo- and pericarditis. Like phthisis, rheumatism is a "white plague;" and in damp, chilly countries, such as many parts of Europe and America, its evil consequences —immediate and remote—if not instantly manifest in all cases, inflict insidious and widespread damage which it is hard to appreciate, and which falls cruelly on many young and otherwise healthy persons.

But it is not the "rheumatic coccus" only which is to blame for these mischievous invasions of the most important organ of our bodies, that part without which all other parts fall into impotence. They may spring from the pneumococcus, the gonococcus, streptococci of various forms, and staphylococci, and the bacilli or toxins of diphtheria, typhoid fever, influenza, and scarlet fever. Carditis in small-pox or measles, if it occurs at all, must be very rare. In bacterial invasions of the coats of the heart these are rarely or never attacked independently; the poisons invade also the muscle of the heart, either by extension of inflammation of the coat from which it can hardly be dissociated, or, in more or less unknown degrees, by direct intoxication. This is conspicuously true of rheumatism, which is prone, if not fatally yet viciously, to attack both muscle and investment. The poison of diphtheria, again, although not always sparing the investments, is prone rather to fall upon the nervomuscular parts of the heart; and the same may be said generally of influenza. The hypothetic agent of scarlet fever attacks both muscle and investments; though in this disease it may not always be easy to distinguish between a pericarditis of direct causation and a pericarditis carried by the crossway of nephritis.

As from these causes we turn to the pathologic phenomena of endocarditis, we find them almost as various; but we cannot definitely distribute the particular features among the several maleficent agents. Of endocarditis of sundry causation we find "simple inflammatory changes" for the most part in rheumatism; though in this disease we find occasionally verrucose forms, or even those ulcerative or necrotic degradations which for the most part depend upon minute and numerous thrombosis. Verrucose or even ulcerative forms are not always "malignant." The rheumatic coccus, maleficent as it is, is not always of the same virulency; moreover, patients vary among themselves in resistance. Nevertheless, generally speaking, it seems probable that in the cases in which endocarditis assumes the more destructive forms we have to do with a septic or mixed infection. Frequent as are the attacks of acute rheumatism upon the heart, and perilous the ultimate consequences, yet the sickness itself is often very mild. In its stealthy quietness, indeed, there may lie a peril of another kind: that, while the vigilance of the physician is abating, hostile incursions may be silently advancing. For the danger, as we know, is not confined to the acute stage of the endocarditis; a valvulitis which during this stage gave rise to no signs, nor to definite symptoms, may at a period long subsequent reveal itself as a foe working in secret; furthermore, a valve thus covertly damaged may, long after convales-

cence, gradually and at length undergo a puckering or retraction to result in incompetence. It is scarcely too much to say that all young persons should lie under a continual suspicion of harboring acute rheumatism; one who has so suffered ought to have his heart examined every few months for two or three years thereafter, and meanwhile should be dissuaded from such bodily exercises as throw any considerable stresses upon the heart and its valves.

But, if many rheumatic attacks are mild, unhappily not a few are intense and destructive. And not only at the time is there some chance of a mixed infection, but the subsidence and even the total disappearance of the rheumatic inflammation are no guarantee against a supervenient septic infection at some later, even distant time; for the passage of an inflammation over the valve seems, long after its extinction, to leave it more vulnerable than in the normal state. It may be less resistent in its tissues, or the mechanical change of its surfaces may give a better hold to microörganisms in the blood.

Now, as we shall see that our methods of treatment of a cardiac inflammation, though improved, are by no means decisive, nor as yet even very efficient, the weight of therapeutics must for the present be thrown mainly upon prevention. The preventive treatment of acute rheumatism consists not merely in keeping children and young people under the best sanitary conditions, but also in watching the avenues of the body whereby this and other infections enter it. That the gate by which the rheumatic coccus enters the body is the tonsil, if not a certain is a probable opinion; and as by this gate not only this microbe but probably many others also find their entry, we cannot give too much regard to the tonsil, a structure in children peculiarly active and vulnerable.

One of my pupils, from the records of the "malignant" forms of endocarditis in more than one large hospital, calculated that not in 50 per cent. of cases was any external wound discovered nor the place of entry traced. If our senses were acute enough we should see ourselves incessantly bombarded by microörganisms, and happily for the most part continually defeating them: as some modern astronomers have conceived of the sun as kept up to its work by a perpetual bombardment of meteorites. Probably these organisms are entering our systems continually, but are destroyed by the defensive "compensations" of the body. When compensation fails, they effect a lodgment somewhere; probably on some part which has been weakened in the struggle for life. However, elusive as the entry of the microbes may be, it is necessary even for therapeutic ends to make in each case the most scrupulous search for any possible source or adit. We shall examine not the tonsils only but also the ears, the mouth and teeth, and the nose; and we shall pursue the search into the inner and outer surfaces of the chest and abdomen; enquiring closely for any traces of leukorrheal or gonorrheal discharge, etc. In a certain septicemic case which proved fatal by pleurisy and pericarditis I regretted we had not at the outset excised a few inches of an inflamed varicose vein wherein may have

been the origin of the infection. The appendix we shall not forget; nor the possibility of ulcer of the stomach or duodenum. Any abscess or furuncle must be laid open and cleansed. A pulmonary or arthritic focus might put us on the track of the pneumococcus. In overt pneumonia we have to contend with both the effects of its toxin and the mechanical disadvantages of the pulmonary embarrassment whereby the respiratory pump is hampered; the right side of the heart may then become dilated, and a significant cyanosis and venous pulsation in the neck may become manifest.

Without analyzing symptoms at any greater length, it may be said that, if in a cardiac inflammation the febrile state be not decisively influenced by salicylates, or if the temperature curve assumes a hectic form, we must apprehend a septic or mixed infection. But we must try to be sure of our ground. A few years ago I was asked to see a patient suffering from a severe and acute affection of the heart; the temperatures were not charted, but the records were very notably and remittently febrile. It seemed certain that, in its initiation at any rate, the infection was rheumatic; but was this still the nature of it, wholly or in part? The medical man in charge assured me that he had pushed salicylates fully, but without success; and in face of his report a mixed infection seemed but too probable. Two days later the patient came under the care of another physician, who informed me that, knowing nothing of the history, he put the patient at once under full doses of salicylates, and with prompt and abiding relief. On further inquiry it appeared that my colleague had indeed used salicylates, perhaps at first in due measure, but, disconcerted by the later exacerbations of the disease, he had not returned to the drug. The lesson to be learned from such cases as these is that recrudescences of rheumatism are as likely as a septic infection, or more likely; and are, of course, much more manageable. Moreover, diagnosis, as in the case described, may depend indeed upon the pharmaceutical test; and, if this test fail, to distinguish between other kinds of sepsis may, in the absence of positive blood or urine cultures, or of some other definitely interpretative sign or symptom, be almost impossible. I may repeat, for instance, that if there be a history or a coexistence of pneumonia, a suspicion of pneumococcic cardiac affection, infrequent as it may be, should occur to the mind; especially if the temperature curves resemble those of a continued rather than of a hectic fever. Hectic curves suggest rather streptococcal infection, when it may be our duty to treat the case with a polyvalent serum; the serum may disappoint us, but the testimony of not a few ameliorations or even recoveries under the influence of such a serum is too strong to be neglected. To such apparent, if occasional, benefits I can myself bear no uncertain witness. The typhoid bacillus again probably always poisons the cardiac muscle, and has ultimately some injurious effects upon the arterial tree; but very rarely indeed—perhaps never of itself—cripples the valves or disposes them to subsequent infections. Diagnosis here depends on other factors; moreover, the physician in all cases will occupy himself

with the phases of the heart, sustaining it and counteracting any disposition to splanchnic vasomotor palsy.

As this is a chapter on diagnosis only in so far as treatment depends directly upon diagnosis, we cannot pursue the differentiation of toxic effects upon the heart in the various toxemias, septicemias, and pyemias; for in many of them the practical effects upon the heart, if not identical, are closely similar. The therapeutic means are those of the general infection, together with those applicable to all cases of acute cardiac poisoning; of specific means of counteracting the toxins themselves only too often we are devoid. If in certain cases the heart is the seat of some previous disability, and thus perhaps the more obnoxious to morbid influences, we shall watch it even the more jealously, if this be possible, even nurse the heart at the cost of some other economies. In respect then of the typhoid and other infections, the rule should be not to allow the patient, however promising his state, to get out of bed until ten days of normal (not subnormal) temperature have elapsed, and this only after many sittings-up in bed, during which the rate and quality of the heart-beats have been carefully noted. For in the acute infections—in pneumonia, for instance—the heart, though perturbed and ineffectual, is often not so much primarily at fault as the vasomotor system; and its failure may be due to splanchnic gravitation with deficient return of blood by the veins. If so, posture is, of course, of the first importance, and the administration of pituitary extract and, possibly, of digitalis for its peripheral constriction, with reflex stimulants, such as pungent odors and gentle massage about the waist and upper abdomen. In extremity direct cardiac massage, though the diaphragm exposed from below may present itself as a last chance.

From these implications of the heart in whatsoever may be going on in the way of obvious infection, we may pass to a group of toxins which have this peculiarity, that even if they may not fail to affect the heart contemporaneously with the general disorder, yet they may do this in a manner so insidious as to give rise perhaps to no signs of a sinister meaning; yet the further manifestation of the poison for some is but deferred to a later date—often even till convalescence seems established. Of these deferred infections—or deferred manifestations rather—those of diphtheria and of influenza are the most eminent. A person, not necessarily a child by any means, may pass through one of these diseases, so far as its acute course is concerned, with apparent security; and yet a sudden spring from a couch or a sudden emotion may shake the infected heart into a fatal paralysis, or a sudden stir of the vagus nerve may suffice to stop it. So terrible an event, when the consequence of infection, is chiefly a feature of diphtheria. In influenza, in my experience, such calamities are less frequent than an arrest or deflection of the process of amendment. The patient does not get on. He is faint on the slightest exertion; his heart distresses him, it palpitates and tumbles; the physician observes that its pulses are irregular, often retarded; and that its dimensions are seriously altered in one or more chambers by atonic dilatation.

On the least effort the cardiac functions are perturbed still more, and by nature's own dictation absolute quiet is imposed. These influenzal hearts, though less treacherous than the diphtherial, take even longer to cure. Often a year or more elapses before the circulation is restored. Accordingly, in treatment we have in the two cases a corresponding difference of principle. In diphtheria we have to ward off immediate perils and, if this be successful, we may hope that the neuromuscular parts of the heart will manifest a progressive capacity to recover health, the period of peril being about six or eight weeks. Dr. John Rolleston says that although after diphtheria cardiac dilatation and dyspnea are often very persistent, yet after the eighth week, unless there is definite reason to the contrary, the patient may be allowed to get up. In these infections the fiber, though the seat of "fatty change," may be so only in this sense, that fatty particles lie in the cells unconsumed; if some of the fibers be changed, as, for instance, in the hyaline form, the myocardium is not carried beyond its capacity of restoration, and even of some current function. In diphtheria, then, if by strict precautions we can prevent a headlong or rapid lapse, the tide will turn. Dr. Dudgeon has demonstrated in experimental diphtheritic toxemia fatty change in the muscle of the diaphragm, which in some cases may account for or aggravate dyspnea. In influenza, however, it is not quite thus—under this poison the heart seems stricken in a different way. In dissection of these poisoned hearts we find not only granular and fatty particles in the fibers, not only—in some of the cases—neuritis, but also a more or less widespread thrombosis of the coronary twigs. In small distal areas, even of the coronary circulation, collateral circulation may be rapidly established; but where it is not, fibrous degradation of the muscle will result in many small areas, and this process, we have reason to believe, to be remediable only by some imperfect process of intrinsic compensation, hypertrophy of some of the cells balancing fibrosis in others. Until gradually this readjustment is attained, capacity must be defective and output moderated. The heart gets a bad start in convalescence, and during the process of readjustment any considerable intraventricular pressures may determine more or less dilatation.

Or the disability may lie in the nervous apparatus, for the cardiac, like other innervations, is in a measure "trophic" as well as regulative. Now we know, in a syphilitic neuritis for example, that long after the specific treatment has neutralized the toxin, and presumably taken out of the nerve that impurity which clung to it, yet the nerve does not recover its activity with the readiness we would fain expect. The paresis—or whatever it be—persists beyond all calculations. So it seems to be with the late heart affections of influenza; the nutrition of the organ perhaps, its activities certainly, remain in abeyance incalculably beyond the time when we presume the poison to have been dissipated. The late influenzal heart closely resembles the heart of strain, as of excessive running and the like; "it takes no end of time to get right again." For many months the least effort may be followed

by extraordinary perturbations, which seem inexplicable except on the supposition of some intimate and persistent damage, muscular or nervo-muscular.

Thus it is that the treatment of these derivative conditions ceases to partake of the specific character appropriate to the earlier and specific stages; and approaches the more general principles of chronic heart affections (see p. 58). In this part of the article, however, it is our business to confine ourselves to the therapeutics of heart disease in the acute stages, of acute endo- and pericarditis which, as we have seen, generally mean "pancarditis"; muscle, valves, and investments being all attacked in their various degrees.

Once more; is there reason to suppose that dangerous acute specific intoxications, such as we here have to allude to rather than describe, may fall upon the heart alone, with but little or no evidence elsewhere of the evil at work? We can hardly suppose that septicemias of the ordinary kind can be at work without some wider manifestations; but rheumatism can and often does attack the heart, primarily as it would seem, while its influence in other directions is for a time suppressed or suspended. Warned by sad experience, physicians of our own day are on the watch for heart trouble in any feverish child; and in an acceleration of pulse or an access of delirium to suspect carditis, although no joint may have suffered. The same experience is true, after its kind, in Bright's disease; and in recent years we have had but too much reason to suspect the same treachery, if less frequently, in influenza. The pneumococcus may, I suppose, attack the pericardium while the lung and pleura are yet free, though I do not remember such a case; but the association of a pyopericardium of whatever bacterial nature with an empyema is an incident frequent enough, latent enough, and hard enough of diagnosis to keep the physician on the alert. Such pathologic reflections as these are of the first importance for the therapeutist, who may bitterly regret the loss even of a few hours in applying remedies against such calamitous events, remedies which in certain diseases—as in rheumatism, for instance—may be of a specific kind.

When, guided by considerations such as these, we are called upon to treat a cardiac inflammation, what steps are we to take? Unfortunately, of the specific remedies we wistfully desire, we have but few: the salicylates in rheumatism, for diphtheria its own serum, and a polyvalent serum for ordinary streptococcal sepsis; a list all too brief. We have no pneumococcal antiserum, but the vaccine has proved in my experience to be of considerable value. In our discussion of the therapeutics we must, with a somewhat artificial division, give some separate regard to endocarditis, pericarditis, and myocarditis. Although myocarditis forms an element in all or nearly all the inflammations of either of these investments, yet it is with considerable variation in degree; in some diseases, as, for instance, in diphtheria, the muscular affection is almost exclusively prominent; in rheumatism it is usually or always accompanied by endocarditis or pericarditis, if not with both events.

The degree of muscular implication is no mere pathologic consideration; for treatment's sake it is of great importance in each case to discriminate, if possible, the associated myositic affection and the degree of it. Speaking generally, if pericarditis may do less ultimate harm to the heart than endocarditis, it signifies a higher intensity of the infective process.

PERICARDITIS

We will take first the cases in which pericarditis is the prominent feature. With some arthritis, let us suppose, there arises a slight delirium, and the pulse, which in this case is more important than the temperature—unless, indeed, this be so exceptionally high as to suggest hyperpyrexia or some severe intoxication—rises notably in number. If the attack be severe, the patient usually complains of pain in the cardiac area, and raises himself restlessly from his pillow, leaning to the left side; his face is rather livid and drawn, and he has some dyspnea. The physician discovers a pericardial murmur, or that peculiar tumbling of the heart's action which, often before any other physical sign, indicates pericarditis; this being the state of our patient, how are we to treat him?

It is suggested that in pericarditis rest is less imperative than it is in valvulitis or myocarditis, and for the reason that bodily movements, by varying the stresses and motions of the heart, may prevent adhesion, or, at any rate, of adhesion over large surfaces. This is a somewhat speculative suggestion, and one, therefore, to be heeded only in so far as obedience to such a rule may not incur other dangers. If there be evidence of concurrent myocarditis, or of accumulating effusion, or of both, we shall prefer the remote risks of adhesion to the immediate perils of stress upon a heart whose capacity may be waning, or whose more collapsible chambers may suffer compression. Even if the cardiac muscle be not itself much poisoned, it may be inhibited by the encircling inflammation, as is the bowel in peritonitis. We shall support the patient in a semirecumbent attitude leaning a little to the left side, and, save for some necessary changes of position, we shall see that rest be absolute. In all cardiac inflammations the patient must be fed and tended like a baby. To rise up in bed might cause a fatal syncope. He must not stir for food, urine, or stool. Coughing must be prevented by a sedative linctus. To secure easy action of the bowels, let those laxatives be given which promote a soft motion without depression, without straining, and without colicky alarms or sudden discharges. Salines are apt to err in all these directions; the old fashioned electuaries answer better, they cause pultaceous stools, and they do not make sudden calls: of such are sulphur, tamarinds, cassia, manna, and, if more activity be required, senna. The compound liquorice powder answers well. In case of greater difficulty the best remedy is castor oil; but only if the stomach is quiet, as vomiting is by all means to be avoided. Of the diet, which does not differ from that in other forms of cardiac inflammation, we will speak fully elsewhere.

On medicinal remedies the first question is whether we shall bleed? For my part, if the patient be fit for it, I apply leeches to the cardiac area—say six to twelve, according to his age and strength. The abstraction, in my opinion, acts favorably in three ways: it relieves pain; it seems to relieve the right chambers of the heart and to ease the organ; and probably it withdraws some blood from the congested area. To blister I am reluctant; not infrequently on postmortem examination of thin bodies, in which blisters had recently been applied upon the chest or abdomen, I have seen on the inner surface of the wall corresponding stains which, if intensified after death, are nevertheless definite enough to signify an irritation of the part which I had rather not bring about without knowing a little more what I am doing. This objection does not apply to blistering in endocarditis, of which I shall have more to say presently. In pericarditis we shall do better to apply the ice-bag to the region affected. When first the ice-bag came into use for visceral inflammations it seemed to me, I admit, an uncomfortable application; but in the practice and reports of others I was led to see not only advantage but also comfort from it. Now I advise it not only in pericarditis but also in endocarditis, and I have little apprehension of harm from it even in myocarditis. An ice-bag is, generally speaking, more convenient than Leiter's tubing; but in cases where great evenness of temperature is desired, or it is desirable to approach the low degrees of cold gradually—as in infants or feeble patients with low arterial pressures and perhaps a tendency to splanchnic atony—the tubing is preferable. If the ice be allowed to liquefy, the temperature of the water will rise, and harmful alternations of heat and cold may take place.

It must be admitted that we have no knowledge and, so far as I know, no sufficient experiments on the effects of local cooling; until some scientific guidance is formulated, we must be content with empirical maxims. Dr. David Lees, to whom we are indebted for much clinical counsel concerning these inflammations, applies the ice-bag directly on the skin of the chest. I prefer, perhaps too scrupulously, to wrap the bag in a flannel cover before putting it in its place, and I am even so cautious as to use cold water on the first application, and to follow this with iced water, according to the indications, before coming to the ice itself. For pericarditis and endocarditis the ice-bag is no doubt better than our older use of poultices, and much more cleanly; but we must see that the bags are water-tight. If leeches have been used, as soon as the bleeding has ceased, the bag can be laid on; many practitioners, without waiting for local venesection, prefer to put on the bag at once. In some sensitive persons it is well to support the bag by a cord to the rib of a cradle, so that it may not lie heavily on the chest. Thus too, in case of high temperature, the clothing can be ventilated by the cradle; and, in case of excessive fever, more ice-bags suspended above the patient. The ice in the chest bag should be broken into small pieces.

The good effects of the ice are usually almost immediate. The

patient's pain and restlessness are assuaged, the temperature falls a little, and the heart becomes more tranquil. It is a matter of common observation that on the application of cold or heat to a particular part the areas of dilating or constricting reflexes extend far beyond the seat of application. It is easy, for instance, to demonstrate a dilatation or constriction of the radial artery on the application of cold or heat to the hand; and probably the ice-bag exercises an internal influence beyond its own area. The duration of the application of the bag must depend on circumstances, but I think there is not much fear of doing harm; so, if the case be an acute one, and the patient, as is usually the case, finds it comfortable, the bag may be applied, even for some days, almost continuously; intervals occurring only when the bag is being changed—say for a quarter of an hour in each hour and a half, and again during sleep, when the ice need not be renewed too punctiliously. During the application of the ice-bag the temperature must be taken at least every two hours; and it is needless to add that if the patient, by chilly extremities, pallor, empty radial pulse, and so forth, betray any signs of collapse, the ice must be used with caution, or even removed altogether. In all cases before its first application the state of the patient in these respects must be estimated, and it will probably be desirable to put a hot bottle to the feet and long woollen gauntlets on the hands. It has been said that after reduction of the more acute symptoms an alternation of cold and stimulant applications, such as hot poultices with some mustard, or a hot bottle, is more efficacious in promoting the dissipation of the effusion than either alone. No decisive advice on this method can as yet be given; it seems too meddlesome. In the graver degrees of chronic heart disease the ice-bag must not be used, as in these cases the skin is vulnerable.

Now during these preparations we shall not forget the importance of certain drugs. We have to consider the nature of the disease, of which the pericarditis is but one manifestation. The great majority of these cases are rheumatic; of the rest, many are beyond the power of drugs. Of rheumatism then I will speak first; and I need not say that for this disease we have a drug which may be called specific—namely, salicin and the salicylate salts. In pericarditis, when probably there is some myocarditis—be it more or less—it has been said that we ought to be chary in the administration of these salts. This reserve seems to me to rest on no solid grounds, and it may lead to disastrous results. One danger there is, and so far as I know one only; this is the danger of vomiting, which disturbs a patient for whom absolute rest is needed. This misfortune is apt to ensue upon the use of the salicylates; we must evade it if we can. Some physicians for this reason prefer salicin, but there is a difficulty in its insolubility. Children cannot swallow capsules or pills. The drug may be suspended in some pleasant mixture; but if the salicylates are administered with a sufficiency of alkali—so that salicylic acid shall not be liberated in the stomach—vomiting does not happen.

And fortunately there is a consensus of opinion that for its own sake this addition, besides the assistance to the digestion of the salicylates, has some virtue of its own. To every 20 grains of salicylate of soda at least 30 grains of the bicarbonate should be added. I have never seen any discomfort from the release of carbonic acid in the stomach, but the mixture sweetened with chloroform and flavored with lemon and mint-water may be administered in many little doses (see formula, p. 40). Let no speculative scruples then dissuade us from giving the salicylates abundantly. We shall give them early, give them freely, and not drop them without good reason. A grave danger in the use of salicylates is discovered to us by Drs. Longmead and Wilcox,[1] namely, that it may lead to symptoms resembling the acid poisoning of diabetes. Fortunately the warning of acetone in the urine and in the breath precedes them by a day or two. With a discriminating but firm rule, remembering what is at stake, we shall continue the antidote rather too long than giving it too briefly or too casually. Under its full use in three or four days both symptoms and signs often diminish rapidly, but mere relief of joint pains is no sign for reduction of the antidote.

Are any other medicines needed? In the stage we are considering I think opium only. This drug, in small doses repeated as required, is a valuable coadjutor. It soothes the patient, contributes to his rest, and may indirectly have some restorative action. Dover's powder is a good form of it, and 1 to 5 grains may be given at intervals, according to the symptoms and the age of the patient. But what about mercury; has it the "antiphlogistic and discussive" properties which are still claimed for it? The claim cannot be asserted nor denied, and I am, therefore, in this practice a trimmer. It is likely that gentle doses of mercury, by acting on the portal system, promote elimination of the products of destruction; and, although I am far from advising "a course of mercury," I never refrain from the moderate use of it. I put a grain of calomel or gray powder upon a child's tongue at first and perhaps another twelve hours later. If it does not scour, I continue at intervals to repeat this, or a less dose, during the next day or two; then I suspend it, but return to it for a day or two every few days. The mouth must be kept clean, for, although such use of mercury as I suggest is far from salivation, yet every precaution should be taken against this evil. Besides, a dry or dirty mouth offers a ready seed-bed for bacterial invasions and penetrations into the ducts. If we use mercury in this limited way we need not add to the salicylates iodids, which make the medicine still more nauseous, and are apt to depress the appetite and the spirits; there is no good evidence, clinical or pharmacological, that the iodids promote absorption of effusions, and the salicylates alone will compass all the purposes which the combination would effect. In ordinary cases—that is, in cases without much myocardial failure or pericardial effusion with consequent low pressures—the salicylate and bicarbonate promote such diuresis as we desire.

That the effusions of pericarditis can be swept out by purgatives,

[1] Lancet, June 30, 1906.

diaphoretics, and diuretics is contrary to my experience, which dictates, on the other hand, that such methods, unless in strict moderation, by lowering the tone of the circulation, are harmful. However, a little sweet spirit of niter is pleasant to children, and a grain or two of nitrate of potash will not make the mixture any more disagreeable. In exceptional cases it is evident that the means of diuresis must be indirect; they must combat the causes of falling arterial pressure. Aconite cannot be serviceable under any conditions which I can suppose, and may be mischievous. Effusions may be stationary for a week or two, and then spontaneously and quickly pass away.

So far then concerning ordinary cases. The two chief ways in which acute cardiac rheumatism may become perilous are by effusion and by myocarditis. To myocarditis we will return presently. An increasing effusion may be dealt with at first by medicine; if medical means fail, we may still find some resource in surgery (see paracentesis, p. 169). As the water accumulates—we are speaking at present of rheumatic cases only, of which pus is rarely a feature—positive pressures are established in the sac. Under such pressure the suction is abated or abolished, and the intrathoracic flaccid walls of the auricles are readily compressed. Under these circumstances—that is, when the right side of the heart may be oppressed by pressures within its sac approximating to positive—neither by theory nor by practice are we led to expect much help from digitalis; diuretin is safer and more efficacious. In this state I think perhaps too little use is made of paracentesis. That I have no strong grounds for saying this I freely confess; the occasions on which I have had the opportunity of putting my opinion to the test are few; but Wheelhouse and myself thus snatched a young man in rheumatic pericarditis from the jaws of death, and in a few other cases I have found it distinctly beneficial. More than once I have regretted that for one reason or another puncture had not been practised. I have never seen the least harm from the operation; with due care there is no reason whatever to dread it. The prevailing argument against the practice is that, bad as they may appear, these patients generally recover without so imposing a maneuver. Happily, indeed, in acute rheumatism and its local manifestations there is a tendency to spontaneous recovery, so that again it is true we are not driven to interfere with an arthritic or pericardial effusion until we see some pressing reason for exceptional measures; but I may be permitted to suggest that many of such patients, had they had the advantage of paracentesis, would at any rate have recovered at less cost of time and suffering. That effusion is useful in keeping the surfaces apart and so defeating adhesion, is, I venture to think, a fanciful opinion. A moderate effusion retreats to the back of the sac, a bulging effusion is perilous to life, and meanwhile is making mischief and distress. The relief by puncture at such a moment is remarkable and welcome; and, were it for this relief only, is worth the inconsiderable risk and trouble.

Have we any other means less drastic of relieving pericardial

embarassment in rheumatic cases? For temporary relief subcutaneous injections of strychnin are very effectual. The milder forms of "counterirritation," such as iodin paint and the like, are useless, even if there be time to await their effects, but it may be well to apply a blister; many physicians of experience advise it. The conditions differ somewhat from those of the first or frictional stage in which I demurred to it. It may help to dissipate the fluid contents of the sac, and we do not know enough of the action of remedies to refuse to follow clinical usage when there are no definite reasons to the contrary. If calomel or other form of mercury has not been given, or but sparingly, this drug may be tried in this stage also; but I repeat that anything like "bringing the patient under the influence of mercury" must be avoided, especially in a disease so prone to impair the blood as rheumatism. The iodids are commonly supposed "to promote absorption." Quinin has its advocates, and it may be combined with salicylates or given alone. Meanwhile, under the gentle opiate, be it a few drops of nepenthe in a child, or in older patients small subcutaneous injections of morphin ($\frac{1}{8}$–$\frac{1}{6}$ gr.), dyspnea and cardiac disturbance will be mitigated. Of stimulants, of course ammonia and ether are readily available, but are very transient in their effects. If alcohol seems indicated, it must be given in fractional doses with a very cautious and watchful hand, as its secondary effects may be harmful Antipyretics of the antipyrin class are to be regarded with suspicion. Very high pyrexial temperatures, even in rheumatic fever with carditis, are quite safely treated by cool bathing or effusion. In two cases of rheumatic hyperpyrexia treated successfully with cold baths no sign of cardiac implication appeared at the time or subsequently.

Position again is of importance. In recumbency the pericardium presses on the lungs and the respiratory pump is checked; as the thin walls of the auricles and great veins yield, the veins of the neck will swell, especially when a cough stops the draught; in the same degree, the left ventricle is emptied. Now roll the patient toward his left side, and then slowly and carefully prop him up, providing also, if possible, that his stomach shall be free from gatherings of wind: no little relief will soon be apparent, and if steady and even support to the abdomen by pad and binder can be tolerated, the pressure may assist in lifting the blood forward.

I think in rheumatic cases in all stages it is of more importance than is generally supposed to apply some treatment to the tonsils. It is by no means impossible that a distillation of toxin may be going on continuously in these structures. The throat must be carefully examined, and suspicion not dismissed merely because no alteration is obvious. The tonsils should be kneaded, as far as may be convenient, every day with a small spatula, and, after thus emptying the follicles, disinfectants, such as sulphurous acid, may be applied. Perhaps a strong solution of salicylate of soda may have a specific efficiency. But if there be any conflict over this operation it must be relinquished, as above all things rest is imperative; still in most children,

and in nearly all adolescents, the little manipulation can be performed without disturbance. In the pericarditis of scarlet fever this method is, of course, even more definitely important.

If the patient be dangerously ill; sick, suffocating, swallowing with difficulty, livid in the face, but death not actually impending, a small subcutaneous dose of morphin may be given, but the inhalation of oxygen is a simpler remedy and usually gives much relief. Perhaps in pericardial effusion this gas gives relief in a greater degree than in any other state of disease. These patients, unwilling as otherwise they are to add to the cumber of respiration, are usually greedy for it, and often protest against any intermission of the gas, which at first, at any rate, we administer only for ten or fifteen minutes in every hour. But if the supply of gas be abundant,[1] and circumstances seem to demand it, there is no reason, so far as I know, why it should not be used continuously. Physiologists tell us that oxygen is an agent not of oxydization only but also of a preliminary process, that of oxygenation; so that the gas is to be regarded not merely as a factor of combustion, but also as a factor of construction, or, at any rate, of preparation for construction. Accordingly, in all cases of heart fatigue it is a valuable adjunct to our therapeutic means.

Of other kinds of pericarditis there is not much to say. If of streptococcic origin, the treatment will primarily be that of the septicemia, and a polyvalent serum may be proper, and occasionally efficacious, as regards the general condition. But in these cases the pericardium is prone to fill rapidly and copiously with pus, and if, as commonly happens, it is associated with a pleural empyema—especially when this is on the left side—the pyopericardium, unless definitely looked for, may escape observation. Operation is the only possible way of relief, and may be needed for diagnosis. Of other remedies in septic conditions of the heart a few words are said under Endocarditis (p. 39). In pneumococcic septicemia perhaps always, and in streptococcic septicemia very often, the microbe can be recovered from the blood, and treatment, by vaccine or otherwise, determined accordingly.

In pneumonia a pericarditis is pretty surely pneumococcic, and in nearly half the cases purulent. In many cases, as Chatard[2] tells us, it is not detected, the exudate being generally moderate in quantity. Generally speaking, it is an event of the gravest augury, for it is at least as often septicemic as due to extension by contiguity. If there be no empyema, operation is more practicable, if somewhat of a forlorn hope.

Tuberculous pericarditis is but a subordinate part of tuberculosis elsewhere, and needs no separate consideration. It may proceed slowly to total synechia.

Actinomycosis in the pericardium, in like manner, needs but a passing allusion; the treatment designed for the general disease will include that of the part.

[1] Apparatus for the readier and cheaper provision of the gas are now devised by Prof. Leonard Hall and others.

[2] Johns Hopkins Hosp. Bull., Oct., 1905.

Embolism or thrombosis of a coronary branch may be attended with local pericarditis, as a pleurisy may follow embolism of a pulmonary vessel. This form of pericarditis is apt to give rise to angina pectoris, and may be syphilitic; if so, specific treatment must be carefully pursued. In senile cases subiodid of potassium and the nitrites are the proper remedies.

The pericarditis of Bright's disease is of sinister omen, perhaps always a herald of death; such, at any rate, it has been in the cases under my observation. It may proceed slowly, however. In a certain patient who came to my chambers with a large heart and a pericardial rub, and with albumin and granular casts in the urine, we managed to stave off death for some months. He submitted most reluctantly to orders, and for some weeks persisted in visiting me at intervals, always with his pericardial friction. He was a lone man apparently, so that I learned little of his history, but he asserted that he had not been ill long. Usually, however, in chronic Bright's disease pericarditis is the last scene of the last act, and thus often passes unobserved. Save as a lesson in carefulness, it does not much matter, as for this item there is nothing specific to be done.

The diet in all acute cardiac disease should, of course, be bland, moderate, and unstimulating; and after apparent amendment these precautions should not be relaxed too soon. In rheumatism too early a return to solid food, and especially to meat, may bring about a relapse. Meat extracts are probably worse than meat itself, especially in renal pericarditis. The excretions must be watched systematically, and the diet—such as the quantities of milk—moderated accordingly. Sips of water in pyrexia are to be allowed or even encouraged. The avoidance of flatulence is considered in another section.

Depressing emotions must be averted as much as possible; with this purpose too much fuss must not be made with physical examination, the necessary observations must be made with as little parade as possible, and little or nothing said about the object of them; but, of course, in little children this precaution is of less importance.

In convalescence the treatment of pericarditis is generally subordinate to the needs of associated conditions, such as endo- and myocarditis. Apart from these embarrassments, I have mentioned the suggestion that to prevent adhesions the patient should begin to move about in good time. I cannot suppose that any moderate reinforcement of the incessant cardiac revolutions can have much therapeutic value; and, indeed, the cardiac muscle and valves are too rarely unimpaired to make any such prescription of much practical application. In respect of prophylaxis I need not urge the great importance of protecting from cold and damp children who have suffered from the rheumatic infection and are suspected of a proclivity to it. During convalescence, especially, any sign of relapse, such as vague pains, restlessness, twitches, and, of course, pyrexia, should be jealously regarded; it is better to waste a few doses of salicin upon the patient than to miss the occasions for its use.

HEMOPERICARDIUM

Sanguineous effusion into the pericardial cavity, if more than a staining of an active serous exudation, is rarely diagnosed, and perhaps never lends itself to treatment. I have seen it once or twice in what I may call, for brevity's sake, blood disorders, when it was discovered only on the postmortem table; and once I saw, with Dr. Humphry, of Cambridge, a case in an old lady, of effusion of blood into the pericardium with pulsus paradoxus. The bleeding we traced after death to the rupture of an atheromatous coronary twig. It is difficult to suppose that such incidents as these will ever be brought definitely into the field even of surgical therapeutics.

HYDROPERICARDIUM

Hydropericardium is used in the sense of non-inflammatory effusions into the sac, as in dropsies. It is doubtful, however, how far these effusions are really passive; a considerable albumin content often indicates a subinflammatory origin. As in the ascites of hepatic disease, and in the pleuritic effusions of heart and renal disease, so in hydropericardium it is probable that some effusions apparently passive are really the result of latent inflammations—of inflammation with little local and no systemic reaction. The question is no mere academic riddle. Careful as we should be in antiseptic precautions, the need of them is greater in proportion to the degree of inflammatory change. If any of the effusion be drawn off it should be centrifuged and examined for cell contents. If the process be subinflammatory rather than dropsical the effusion is more likely, *cæteris paribus*, to return, and aseptic methods are most imperative. In diseases likely to bring about hydropericardium the signs of this effusion should be sought from time to time, for a latent effusion may yet be very copious; so that, as I have witnessed on more than one occasion, paracentesis may be needed and successfully practised. In scarlet fever with nephritis, in chronic renal disease, scurvy, cancer, and the like it is very apt to occur and to lie latent. In cancer, however, it is nearly always a terminal event, at which stage paracentesis pericardii can rarely if ever be expedient. The same event may happen, though far less frequently, in tuberculosis. Nor must hydatid be forgotten. Hydropericardium is often, of course, associated with pleuritic effusion; in these cases the pleuritic effusion will be tapped first, when the hydropericardium may recede; if not, and the state of the patient is hopeful enough to justify further interference, paracentesis of this sac also may be readily and harmlessly practised afterward.

PNEUMOPERICARDIUM

Pneumopericardium is a rare event, which may arise from a wound, fractured rib, or perforation by disease in some neighboring part. The treatment would be in the main or wholly surgical.

ADHERENT PERICARDIUM

This result is often very difficult of recognition, though we are ready to suspect it whensoever an enlarged heart—rather dilated than hypertrophied—is found to be laboring under difficulties, yet without any valvular, renal, or other lesion to account for it. This disease of the heart will, however, be considered in the chapters dealing with chronic cardiac disease, as the therapeutic principles will not differ essentially from those of embarrassment arising from other causes. Plastic or releasing operations upon the chest in this synechia are dealt with elsewhere.

ENDOCARDITIS

Much of what has been said on pericarditis will apply to inflammations of like nature attacking the inner lining of the heart. Probably in most cases of pericarditis but little ultimate harm ensues from this lesion alone, the abnormal adhesion not being of great extent about the heart or in the mediastinum, and in young persons this organ and the surrounding parts more readily adapt themselves to the new conditions. Only too generally, however, in acute rheumatism pericarditis is associated with endocarditis. Without entering into the more intimate pathologic descriptions which are scarcely within the sphere of this work, I may remind the reader that if it be important at the outset to leave no stone unturned to mitigate pericarditis, still more vigilance is, if possible, demanded of us in respect of endocarditis. As we have seen in pericarditis, the first use of our vigilance is to make ourselves aware of its initiation at the earliest moment; I had almost said before it begins. In every feverish cold or the like in children the heart should be minutely examined at least once every day, and any acceleration of its rate or alteration of its rhythm suspiciously noted. It is better to treat a cardiac inflammation which does not exist than to omit to catch in its incipient stages one which is slipping in stealthily; for the tiniest spark of it in the cusp of a valve may, and indeed probably will, leave some enduring spot upon the delicate film which stands between us and disablement, or mortal disease. Therefore, I would strongly urge upon the family physician, who may often see acute rheumatism from the outset, not to wait even for those slight signs of irritation of the heart to which I have alluded, but, while the disease is still manifest only in the outworks, to enjoin absolute rest, and perhaps to apply the ice-bag to the precordia. It is not in all cases that the pain in the joints imposes the condition of rest before the physician's warning is needed.

The position of the patient in endocarditis is not the same as in well-marked pericarditis; he is not disposed to raise himself in bed and to lean to the left. Thus the ice-bag is easier of application. Whether in endocarditis, removed as it is from the walls and coverings of the thorax, the ice is as efficacious as in pericarditis, it is not easy to say with confidence; we know little of the conduction and mode of

influence of outward applications, hot or cold. At least it soothes and moderates the action of the heart when it is excited, and probably works for good in a still more intimate manner, perhaps by reflex paths. The demand upon the salicylates, the freedom in their use, and the need of continuing them in smaller but still substantial doses (as follows), steadily and persistently, however prompt and immediate relief may be, is as true for the one inflammation of the heart as for the other.

℞. Sodii salicylatis..... gr. x–xx;
Sodii bicarbonatis..... gr. xx–xl;
Spiritus chloroformi..... ♏ xv;
Syrupi limonis..... ♏ xl;
Aquæ menthæ piperitæ.....q. s. ad. ℥j.—M.
S.—Every two, four, or six hours.

Rheumatic endocarditis is more common than pericarditis, and sooner or later more frequently injurious. As in pericarditis, an element of myocarditis is perhaps always present; perhaps, indeed, whatever the specific cause of the inflammation, myocarditis is usually an element important enough to demand consideration. Opiates are not so generally necessary as in pericarditis; in endocarditis the pain and distress are less; indeed, a severe endocarditis may pass through its phases without any local discomfort whatever. Hence the need for us to be incessantly on the alert. The first effect of the microörganism is to erode the epithelium, thereby producing a lesion for repair; but this is not all, some deeper intoxication is followed by reaction in the texture of the valve, usually, of course, in the first instance, in the more vascular mitral valve; and this is attended by thromboses of the finer vascular network. If by ice and neutralization of the poison we can stop the process at this point—and there is some clinical evidence that we may—we can prevent much small-cell infiltration; the subsequent puckering of the valve may be prevented also. With this ultimate issue in view, and seeing that at every revolution of the heart the valves must be set more or less taut, Sibson, and recently again Dr. Caton, have emphasized the importance of rigid rest for as long a time as the valve or valves may conceivably be unsound or tender. The duration of this prevention of every avoidable rise of arterial pressure is so protracted as to make a heavy demand on the intelligence and patience of the patient and of his friends. As in respect of the heart we have urged remedial precautions at the outset of every case of acute rheumatism, whether signs of cardiac irritation have been audible or not, for even in case of slight inflammation such signs may be fleeting, fallacious, or absent, so I would urge even excessive restraint in the fear of secondary deformation. Supererogation is here a rule of virtue. It is better to make any reasonable sacrifice than to run any such risks, for a valve may not betray incompetence till long after the storm is over and may be passing into oblivion. On the other hand, if a systolic murmur at the apex be "hemic," or due only to atony of the muscle, its nature will become evident by the return to normal conditions; and meanwhile no harm will have been done. Especially,

we are warned not to relax the obligation of perfect rest because the salicylates may have brought about some amendment. Douglas Powell and Caton prescribe periods of complete rest in bed for two, four, or six months after defervescence, according to the severity of the case; but in the later weeks of this enforced recumbency massage may be cautiously tried, and, if the heart be not excited, should be continued. If the small opiates advised for pericarditis are not so necessary in endocarditis in respect of the relief of pain, they may be needed to secure the apathy which makes for bodily quiescence, and, if there be a cough, to prevent its agitations. Caton, while relying chiefly on rest and salicylates in rheumatic endocarditis, at the same time uses small blisters, frequently repeated. These blisters may, with no loss of any virtue they may possess, be applied around the cardiac area, so as to leave the region of the apex free for the full and unrestricted use of the means of physical diagnosis. Powell is disposed to endorse Caton's opinion of their usefulness, and at any rate they are harmless.

Of mercury I have the same report to give as under pericarditis: although its part is subordinate, in due subordination it is a valuable adjuvant. Moreover, it tends to keep arterial pressures down. It is not desirable, however, to use it at all freely if the myocarditic element be manifest, and it is in this case only that oxygen is likely to be required. That the iodids "discuss" or prevent fibrosis is a current notion to which we ought perhaps to give some attention.

As a main element in cardiac rest I may refer here again to the stomach, concerning which I have to speak at length in a later section; not only as concerning conscious dyspepsia, but also that atonic distention of the viscus which, as in phthisis so in both the acute and convalescent stages of heart diseases, is apt to play so mischievous a part. The meals are to be small and frequent, neither hot nor cold, and fed to the patient while at rest. Strong tea and coffee should be avoided. I conjecture that in rheumatism the toxin affects the muscular coat of the stomach as it does that of the heart itself.

In convalescence from endocarditis indeed we are not anxious to restore the general health too fast. Even to feed up the patient, and to enrich and increase his impoverished blood, may excite some distrust. Some languor of the heart, some poverty of the blood, some diminution of its mass—which may be reduced still further by restricting the fluid consumed—are conditions mechanically favorable to the repose of a suffering valve. A light ferruginous tonic, such as the citrate of quinin and iron, will be useful if anemia be too apparent:

℞. Ferri et ammonii citratis..... gr. v–x;
Tincturæ nucis vomicæ..... ♏ viiss;
Tincturæ calumbæ..... ʒj;
Aquæ pimentæ.....q. s. ad. ʒj.—M.
S.—To be taken three times daily.

During the convalescence also, we shall endeavor by such medicines as may be necessary to promote the several excretions of the body, in order as far as possible to reduce peripheral accumulations and stresses.

Free lungs, free kidneys, free liver and bowels, and a light burden for the stomach are the primary points to be secured, while the prolonged rest in bed is to be as absolute as good nursing can secure. Even when the patient is allowed to return to social life we shall insist upon such rules of conduct as may tend to prevent sharp rises of blood-pressure: we shall still keep a vigilant watch over the freedom of the secretions, we shall see to the lightness of the labors of the stomach, and we shall insist upon the restriction of sports and other physical exertion; and we shall not remit this personal expert criticism for at least six months. Patients, or their friends, to whom the facts of the matter are explained, will surely act even with pedantic and fastidious caution rather than run the risk of protracting a process fraught with such dire ultimate results to the central organ of life.

If in the failure of the salicylates, in the severity and tenacity of the symptoms, and in the character of the temperatures, it seems that rheumatism, bad as it is, is not the foe we have to fear; if it seems that the endocarditis depends on some other infection, or on a mixed infection, unhappily our remedial means are reduced as our difficulties increase. If we suppose the infection to be by streptococci, the use of a polyvalent serum, as advised in pericarditis, is urgent. It may be administered per rectum, it is said, with no loss of efficiency.

But we must not fold our arms and suppose that if serum or vaccine fails, no medicines are of any service whatever; in septicemia I am convinced that by some other measures good is to be done, even perhaps to the tiding a patient over degrees of peril into recovery. If petechial phenomena arise, cocci will usually be discoverable in the blood. Any source or focus of poison in the body—as in the throat, nose, ear, teeth, or elsewhere—must be scrupulously hunted out and eradicated. Not only rheumatic but ulcerative endocarditis also may enter by way of a tonsil. Among internal medicines quinin in full doses is usually administered. With the quinin I advise the use also of the sulphocarbolate of soda, given in bold doses: to an adult who tolerates the drug, 30-gr. doses every three hours. Dr. Bacher, of Paris, has advised in septic endocarditis the administration of yeast, a convenient dry preparation of which is in the market; Douglas Powell also states that he has seen good effects from its use in these cases. It is perhaps best to give it subcutaneously, as a fairly concentrated culture in saccharine water, of which 20 to 30 minims are injected every second day, perhaps for many weeks. It may be used conveniently with the other remedies, and in these alarms polypharmacy is better than the neglect of any possible factor of cure. Collargol, or colloid salt of silver, has its advocates; Wenkebach is somewhat disposed in its favor; other observers deny its efficacy. Arsenic also has been recommended in these septic conditions. But I must say that, in default of notable evidence either practical or theoretic in favor of these latter drugs, I shrink from piling one poison upon another, especially in cases in which myocarditis may form a substantial element. Of the use of digitalis or strophanthus in endocarditis I have nothing to say; apart from myocardial flagging, a

problem which will receive especial consideration presently, I never was tempted to use it, for in acute valvulitis a drug which raises arterial pressure would rarely be appropriate. So long as the heart can get along, the less stress upon the valves the better. Within limits a feeble systole may not be without its advantages, and disquieting degrees of acceleration or throbbing may be moderated by the ice-bag. Yet, so complex are these problems, that cases may arise in which a reinforcement of systemic arterial pressure by some means may be a pressing need. Collapse in septic cases is a compound event; the failure is neurovascular as well as cardiac; and although the relations of these variables in a particular case are often obscure, yet palsy of the vasomotor center may be the larger, even much the larger, component, and the need of splanchnic vasomotor tone imperative, at whatsoever trial to the heart itself. Of cardiac tonics, diuretin may be given without much fear of harm.

In or soon after scarlet fever a carditis may be brought in on the chain of acute nephritis. The physician can scarcely fail to take a view of his case large enough to recognize this series of events, and to regulate his treatment accordingly.

Endocarditis arising during chorea requires no separate consideration, save that on the first sign of chorea itself salicylates or salicin must be given in doses as large as the age and condition of the patient permits, and the doses of the drug should be reduced slowly and reluctantly. Dr. David Lees[1] assures us—and in a state so perilous we cannot neglect any suggestion from such a source—that if we give doses large enough the salicylates help us with the chorea itself also. He administers to a child—say from six to ten years old—10 grains every two hours, increased every third day or so to 15 grains and 20 grains. Such doses must, of course, be carefully watched, and it is imperative that the salicylate be combined with twice its weight of sodium bicarbonate. During the night the frequency of the doses is reduced to every four hours. In chorea also the state of the tonsils must be continuously observed. In convalescence from chorea the continuance of rest must be as carefully prescribed as after rheumatic fever.

Of endocarditis due to tubercle no special consideration is practicable; it will be no more than a subordinate item in a general tuberculosis. Nor is any detailed consideration necessary of the treatment of cases of cancer, or other independent disease, extending to the heart by contiguity.

In exhausting and prolonged cases, and especially if emaciation be extreme, bed-sores are to be jealously guarded against. In rheumatism abrasions are apt to be aggravated by the profuse acid sweats; and in other cases by the contact of some such irritating damp as urine. There is but one effectual way of preventing bed-sores, and this is to let it be understood that the appearance of a sore back will be followed by the prompt dismissal of the nurse in charge. In some cases, as during times of obscured consciousness, it is her duty to pass her warm hand under the patient every ten minutes; the least wet must be care-

[1] Lees, D. B., Acute Visceral Inflammations, London, 1904.

fully dried away, the parts dusted, and the draw-sheet changed; occasionally a little spirit may be rubbed gently upon the skin, but it is well not to seem to rely upon lotions or other local remedies, lest the primary duty of dry cleanliness be subordinated to such medications. The prevention of bed-sores at the coccyx in orthopnea will be considered in the sections on Chronic Heart Disease.

MYOCARDITIS

We cannot stay to enquire how far acute affections of the cardiac muscle are pathologically to be called inflammatory; that generally they have some quality of inflammation seems probable; but it is no less true that—yes, in most cases—there is a large element of toxic necrosis or myolysis, especially, for instance, in diphtheria; and also in many a variable neuritic or myoneuritic element, as seen eminently in influenza. At the time of writing I am seeing a patient with cardiac disorder and brachial neuritis after influenza. But as the principles of the treatment of acute myocarditic failure are, apart from antidotal methods, the same for typhoid, diphtheria, septic conditions, rheumatism, and the rest, and, therapeutically speaking, differ only in the degrees of distribution of the several elements of the muscular impairment, we may conveniently discuss them together. Confused as these factors, vagus and vasomotor functions, blood-pressure, etc., may be and often are—in death from diphtheria, for instance, the disease has been found in the vagus many weeks after the infection—it is of no little importance to analyze their relative prevalence in the particular case, not for prognosis only but also for the treatment to which prognosis may be a guide. But as a class these cases may all be regarded as adynamic. Thus, in influenza the neurolytic element may be pre-eminent; in diphtheria, the myolytic; in rheumatism a combination of more or less active inflammatory reaction in the muscle with a variable inflammatory attack on its investments, inner and outer—the "pancarditis" of Jürgensen. In influenza, then, we expect to find arrhythmia an early symptom; in rheumatism a slackening of the heart's efficiency, both from inherent disability, and, if pericarditis be present, from some not very readily calculable loss of pericardial support, and if valvulitis be present, some perversion of the courses of the blood from chamber to chamber; in diphtheria, a mere myolysis, or neuromyolysis, without inflammation of the cardiac coats or valves, a state very difficult of detection, yet for its latency none the less sinister. I repeat that too often, indeed, in diphtheria the patient's death is the first and last symptom of the deterioration of the fiber of his heart; in most cases we infer rather than detect neuromyocardial degeneration, and in so anxious a dilemma anticipate the worst that we may do our best. Indeed, it is said that under infection a heart may fail in which, after death, no evidence of lesion can be detected. We shall also look narrowly at the signs and symptoms of the general circulation, so as not to mistake relaxations of the periphery for primary cardiac failure.

In typhoid fever Stengel says that the cool bath method has "greatly reduced the tendency to excessive cardiac weakness." In rheumatic cases the degree of the myocarditis does not vary directly with the inflammation of either or both of the investments; although in bad cases we may well presume that in the sum of the effects it is not wanting. I have ventured upon the reflection that in valvulitis a degree of diminished energy of the cardiac muscle, or even a temporary tricuspid regurgitation, may not be without some advantage in relaxing stress upon the valves, a relaxation to which we may contribute by scrupulous enforcement of the several means of rest on which already I have laid so much stress; and the heart may be soothed by the cautious use of small doses of chloral. Happily in rheumatism, rapid and large as dilatation may be, the intimate impairment of the muscle—the myolysis—seems not to be so great or, at any rate, not so malignant or aggravated by neuritis, as in diphtheria; thus in rheumatism, clotting apart, we are not so often taken unawares by sudden syncope as in diphtheria. Practically always, I think, in acute rheumatism symptoms or signs, or both, appear in time to warn us of what is on foot: evidence such as acceleration of the pulse, delirium (the nurse must always be catechized about any night wandering), precordial pain, signs of dilatation, etc.

There are points in the observation of physical signs on which, although this work is therapeutic in intention, we must touch in so far as they are guides to therapeutics. On a precise verification of the changing conditions with which we have to deal, and on a precise adaptation of therapeutic means to correspond with these, success must depend. We have in each case two aspects of the phenomena to consider; namely, what are the dynamic or functional conditions in the particular case? and, second, what are the static conditions of its chambers and valves? Suppose, as the easiest malady to discuss, we take a case of rheumatism, and from it derive rules which may suffice for other and less well-defined maladies.

How, then, in the particular case is the blood distributed in the body? Of the variations of the cerebral circulation it is not easy to speak. The delirium, which in children, at any rate, we find to be a frequent accompaniment of carditis, consists not in mechanical conditions only; there are febrile and toxic elements also which it is not easy to discriminate. But by the veins of the neck we may detect an increase in the venous pressures in the upper parts of the body. By raising the arm slowly to the level of the heart and upward we may ascertain the readiness with which the visible veins empty themselves; in case of extreme venous pressures we may perceive a wave in the large veins on the forearm or even on the back of the hand. In earlier stages we may be able to note the degrees of respiratory suction upon some superficial vein of the neck. By percussion and auscultation we shall estimate the state of the pulmonary circulation. Incipient degrees of pulmonary engorgement are betrayed by slight degrees of dulness on percussion and defect of respiratory murmur; higher degrees by wheezes and crepitations. An abnormal stress upon the pul-

monary valve may be notable. If the myocardium be deeply implicated tricuspid regurgitation may occur, whether audible or inaudible. Von Basch has laid much emphasis on the loss of suction consequent upon even moderate degrees of restriction of the pulmonary and diaphragmatic excursions, due to more or less stiffening of the lungs by congestion. Any sign of pleuritic effusion which, in such cases as we are now contemplating, will, of course, be more probably inflammatory than passive, will attract attention. On turning to the abdomen we shall thrust the hand gently under the right ribs to ascertain if the liver is tender, which would indicate congestion; or the viscus may be palpably enlarged. Edema of the ankles is scarcely likely to occur in the cases we are now considering, but the filtration of small quantities of albumin into the urine may indicate some congestion of the kidneys, and thus we may learn that the blood is ill distributed, that the veins are too full and the arteries relatively empty. If the patient can be moved, we shall compare the pulses under variations of position. We may now take the arterial pressure with the manometer to ascertain if and how far it is diminished; if we are skilful enough, we may take also sphygmographic tracings from the neck, after the method of James Mackenzie, and compare thereby the time relations of jugular and carotid diastole, a comparison often of great practical value. Finally, by examination of the cardiac area and sounds, we shall endeavor to detect the form of the heart itself. This part of the examination, however, is beset with fallacies and obscurities on which we must dwell briefly, and once for all.

We are too deeply indebted to the early pioneers of the so-called Nauheim treatment—to Ling and the late August Schott—to judge their tests of success and failure severely. The routine of physical examination was applied to somewhat novel conditions, and we can scarcely wonder if at first their methods were fallacious and their interpretations somewhat crude. Perhaps this apology is not quite so fully available for all their enthusiastic disciples.

Students commonly present themselves for an examination imperfectly trained in physical methods, and ill-trained men are not very likely to improve their skill in after life. Even if we make the large assumption that in disease the dimensions of the heart and of its several parts may by physical methods be definitely delineated, there remains the embarrassment that these dimensions are very far from being even temporarily constant. When impeded by disease the chambers of the heart seem to be continually altering in size, partly, of course, in submission to the larger disturbances of the currents of the blood, but also no doubt of tone, conductivity, contractility, and reflexes. In the rhythm of all moving things the rhythm of the heart is the most regular; but as by disease this quality of motion is impaired we meet with less regular and more fluctuating periods and sequences. Furthermore, it is well known that even in health variations in the capacities of the cardiac chambers are frequent, and recent observers (Abram and others) have discriminated more and more accurately between internal

and external (reflex) influences; so that even considerable apparent or real changes of dimensions under strong reflexes, such, for example, as baths, massage, exercises, or other less obvious influences, are far from signifying net or abiding gains or losses. Again, although the well-known variations of measurable area due to posture are better defined than formerly, they are not without effect as sources of fallacy in physical examination. The lateral swing of the heart has long been used by many of us as a test of unhealthy states—as in "nervous debility," and in degeneration of the aorta—a swing which may be so wide as largely to modify our physical appreciations. Lastly—to touch only on the chief sources of fallacy—the relations of the neighboring viscera to the heart are very changeful and perplexing, and need close vigilance if our appreciations are to be relied upon (Wenkebach). Of these shifty viscera, the lungs, the stomach, and bowels, with the corresponding changes in the diaphragm, are the most important; viscera which, under large variations of tone and content, encroach upon the heart or recede from it. Thus, when the heart is to be measured, the utmost care must be used in our methods for the precise observation of uniform conditions and net estimates, and reliance placed especially on deep transverse measurements; the only really trustworthy method is orthodiagraphy, which, under very accurate conditions unfortunately, is, as yet at any rate, applicable only to special cases. Again, as the relations of the several parts of the heart and of the surrounding viscera, whether due to intrinsic or extrinsic variables, are thus unstable and often fleeting, we cannot be content with single examinations, but these must be repeated at certain not infrequent intervals. Notwithstanding, disconcerting as all these sources of fallacy may be, we may enter upon physical appreciations of the heart with some assurance, if due provision and observation are taken as far as possible into our reckoning. We shall discover the areas of the lung and stomach; we shall prescribe the same posture in all our examinations; we shall estimate the effects of foregoing reflexes, and of vascular tides, and the duration of their effects, not forgetting some reflex effects of our own manipulations. Finally, we must be content to confess that, however refined and discriminating our methods, we cannot expect from them more than a certain approximate value, so that we must check the physical signs and the more general symptoms one against the other.

Thus in myocarditis we have to estimate the driving capacity of the heart, and how far by diminished conductivity, contractility, or tone this is impaired; for a true estimate of driving power of the several chambers, in use or reserve, lies at the root of methodical treatment. If the cardiac muscle can be relied upon, and if the damage done be not overwhelming, we may expect it to resume some steadier efficiency if, by redistribution of the blood, the abnormal stresses can be mitigated. We have seen that the degrees of infection and deterioration of the muscle are, however, often inscrutable; and the problem can be solved only *ambulando*. We must remember that orthopnea (apart from pericardial effusion) does not often appear in these cases. Still we are not without

means of provisional judgment. If we find, as I have said, that in a pallid, prostrate patient, although the lungs are not much blocked, the veins of the neck do not subside; if in curves of pulsation from the neck, the jugular and carotid summits are unduly separated; if the veins of the arm do not empty quickly on raising the limb to the level of the heart; if the pulse, abnormally slow perhaps, as may be in influenza, on the first brunt of the poison, be rising in rate, of unstable rhythm, and unduly influenced by change of posture; if the area of precordial dulness is moving outward and the impulse diffuse; if the first sound at the apex is ill expressed or "valvular" in quality, the first or muscular portion of it being reduced, or as if reduplicated but with that apparent duplication which often passes into an atonic regurgitant murmur or is suppressed by digitalis; and if, at the same time, the arterial pressure as measured by the manometer—which is quite easy of application even to the most prostrate patient—is falling, we should suspect, at least, a considerable impairment of muscular tone, and in toxic cases a profounder affection of the tissue. The clinical symptoms may proceed from pallor and restlessness to lividity, delirium, or stupor. In influenza and diphtheria such changes, in slight degrees, may be detected in most cases of any severity; and must be especially looked for in the second week. Unfortunately, registration of blood-presures does not always foretell the danger; even in cases proved to be myocarditic, other variables intervene. The arrhythmia to be noted with uneasiness is not so much a change of rhythm—a pararrhythmia, if I may coin such a word—as a confusion of it. A substituted rhythm, *e.g.*, a pulsus bigeminus or a mere intermittency even at irregular intervals, may be due to some transitory nerve interference, or to the influence of a drug, such as digitalis or atropin, and not to intrinsic muscle defect. But if in a soft and ill-sustained pulse the systolic pressures become unequal, even if the inequality be occasional, we have to do with a more sinister form of irregularity. In these cases frequent records of arterial pressure, and comparison of pressures beat by beat, are of great prognostic value; they are as important as the records of temperature—not infrequently more important. The urine will, of course, be tested at least daily for albumin.

In scarlet fever the apprehension of acute nephritis has been alluded to; in such cases a distension of the heart has an equivocal significance: it may be due to primary myocarditic failure, but it may be secondary to renal infection, or again, to a combination of these evils. The arterial pressure in scarlatinal nephritis may, indeed, be rising, but this rise is often a little later—seven to fourteen days later—in declaring itself. Now, as the local bleeding, laxatives, diaphoretics, which in infective cardiac failure would be untimely, may, in acute nephritis, be appropriate means of cure, the records of the sphygmomanometer cannot be neglected. In diphtheria, on the other hand, pressure measurements are necessary, in view, not of a rise but of a rapid fall. I have said that in diphtheria, in my experience, although occasionally acute dilatation of the heart may present itself suddenly,

yet, impaired as the heart may be, it is not as frequent an event as in influenza; indeed, distention of the left ventricle is often conspicuous by its absence; by vasodilatation the arterial pressure may be too low to produce it. In this disease, then, in which heart failure may be acute and early, or appear swiftly in the second week or later, the manometrical record of arterial pressure at frequent intervals is more essential, and may discover to us that the heart failure in this disease is not so sudden and "unexpected" as it is said to be. A falling gradient of arterial pressure, if looked for, may be ascertained in good time; but the physician must remember that by touch we are as little able to perceive these gradations as to record gradients of temperature.

On such methods as these, then, we shall determine the principles of treatment in "myocarditis," that is, in failing heart from poisoning of the muscular fiber. For my part, I use digitalis very little in acute heart diseases; during pyrexia its virtues are less conspicuous, and the drug is not wholly to be acquitted of occasional treacheries. Moreover, one warning of intrinsic cardiac failure, especially in diphtheria, is nausea or even vomiting, and if this condition were set up or aggravated by digitalis, it might mask or aggravate the course of the disease. In acute impairment of the cardiac fiber it may be well to moderate the influence of the vagus by the administration of atropin, and this the more anxiously if we suspect toxic irritation of this nerve. In angina pectoris this moderation of the vagus has been my practice for some years past (p. 162). Methods of treatment of an alarming or worrying kind—such as sprays, antiseptic lotions, and the like—unless urgently needed, should for the heart's sake be avoided. In acute failure, however, time for rest and repair must be of the first importance; we must try to provide against surprise of the heart by other means, not forgetting a jealous supervision of the movements of the stomach and voluntary muscles. How grievous vomiting may be in cardiac impairment we have witnessed but too often after anesthetics. Yet we are in some dilemma nevertheless; we may have to decide again and again between the claims of the system upon the heart and the momentary capacity of the organ itself; to decide whether for the body's sake we are to stir up the heart with "cardiac tonics," to let the body take some denial or risk in order to conserve the fountain of its life, or to force the heart to provide for its own intrinsic circulation, its own fountain of energy. In such doubts a perusal of the pressure curves will help us, from time to time, to decide upon our measures. Fortunately, it would seem that in acute carditis the disability of the heart is not altogether due to perishing fiber; the fibers seem in great part, at any rate, to be only enfeebled under the ambient poison, or, perhaps, merely incommoded under an interstitial compression. So far as these may be the conditions—and they may count for not little—we may find ourselves justified in a cautious application of the spur, even to an intoxicated heart. What are such spurs to be? With digitalis, the drug to which we turn at first thought, we have seen that there are many, too many, drawbacks and cautions, unless in cases of mere dilatation in slack

rather than poisoned myocardium. Strophanthus is less counteracted by pyrexia and in some other respects is more manageable; but it too is apt to disagree with the stomach. If a preparation of known strength can be obtained, which is not always easy, it is to be tried cautiously, the pressure gradient being watched meanwhile. Strophanthus, caffein, or diuretin, by increasing the tone of the heart, by promoting, that is, a reduction of the mean length of its fibers, may thereby empty the coronary veins and squeeze out noxious juices and embarassing infiltrations.

But we must not forget to consider the treatment of the myocarditic element from the outset. The time is gone by for antitoxic serums, the mischief is done, or, at any rate, the toxin is anchored to the tissues. When in endocarditis and pericarditis we apply the ice-bag, do we apply it with a view to the myocarditis also? I scarcely know how to answer this question. Perhaps we cannot thus influence the very independent and extraneous circulation of the heart, and if we could we might well shrink from interference with so intimate and vital a function. On the other hand, there is, I believe, no reason from experience to apprehend in ordinary cases any harm to the cardiac muscle from the application of the ice-bag or other proper means of external treatment; and possibly by it some favorable effect upon the tone and nutrition of the fiber may be attained directly or by reflection. Experimentally, ice applied to the cardiac area does not affect the pulse in rate or quality, nor does it lower blood-pressure or temperature. Nevertheless, if there be reason to infer that the myocarditic element forms a large part of the morbid process, as, for instance, in diphtheria, our prepossessions would be toward external warmth. In threatened collapse, and in early degrees of it, we know that hot applications are more efficient and grateful than cold; and if the cardiac muscle is yielding under intoxication, we have, approximately at any rate, conditions of incipient collapse. The sensations of the patient may be taken as some guide in these respects. As to the salicylates, there is, I repeat, no definite reason, clinical or other, for the apprehension which seems to deter some physicians from administering them as boldly as circumstances indicate, even when myocarditis is plainly evident. In rheumatic cases, the only cases in which salicylates are likely to be required in any quantity, surely the most antidotal drug we possess should be pressed in proportion to the effects of the poison, whether these effects lie in the muscular structures or elsewhere. The nearer the peril to the center of life the more closely do we cling to any reasonable means by which the evil may be neutralized or attenuated. Nausea and vomiting are, it is true, symptoms of ill omen in the approaches of myocarditis, and, as I have already said concerning digitalis, if it be only to avoid masking the symptoms, a drug apt to induce these results should be economized; yet we shall not let slip a valuable means of relief if by any means we can adapt it to the conditions of the case. This I think we can do, and if so, I know of no factors by which the salicylates would coöperate with the rheumatic poison for harm. I have said

that salicin may take their place, but, we have seen that if the salt be guarded by a liberal addition of bicarbonate of soda the nauseous disengagement of salicylic acid in the stomach will be prevented. I would dwell upon this part of the treatment not only because of its importance, but because, in practice among my professional brethren, I have found a prejudice against a bold use of the only remedy in rheumatic myocarditis which promises to counteract the virulence of the specific poison. I agree with Dr. David Lees that salicylates or salicin with a bold hand, the ice-bag if inflammation of the investments seems to predominate, or warmth to the precordia if myocarditis be the chief feature, are our most proper early remedies.

Suppose, nevertheless, that the myocarditic element forges ahead; we have tried salicylates, hot epithems, absolute rest, gentle opiates, perhaps, and ordered the diet so strictly that the stomach shall not be distended; nevertheless dyspnea increases, the pulse quickens, is retarded, or irregular; a systolic murmur is heard at the apex, or the sounds approximate in quality, the urine falls in quantity and albumin appears or increases in it, the face is pale rather than blue, and restlessness and delirium are menacing. What more can we do? Shall we give alcohol, for instance? I think we ought to try it, cautiously watching the pulse, and using, if possible, the sphygmomanometer; but no large quantities are needed. The end to be gained is some stimulating effect on the heart, perhaps by way of a stomach reflex, helping the stomach a little likewise and reinforcing the diet; relief is given to the heart also by reduction of peripheral resistance, *i. e.*, by vasodilatation. If the cardiac embarrassment then seems to be due not to large vasomotor dilatations but to vasoconstrictions or to primary neuromuscular affection, a little diluted brandy, light pure sherry, or good claret may be given; the claret is usually acceptable to a feverish patient. The doses and effects must be watched closely—not left altogether to a nurse, and the doses increased or reduced as the symptoms, especially the pulse, indicate. Champagne contains acetic acid, it is apt to distend the stomach, and in its best brands—and these alone are to be recommended—is too expensive for general use. If expense be no matter, this wine is exhilarating, but it should stand in the glass until the active effervescence subsides. A little carbonic acid in solution will do good rather than harm in promoting contraction of the stomach by direct irritation of its wall. For large doses of alcohol I have never seen the need, nor, indeed, felt sure of the safety of them. Its use lies in dietetic or cordial doses; and especially in the rigors or chills of septic cases, when generous doses of a hot alcoholic drink not only comfort the patient but tend also to liberate the vasoconstrictions.

In case of acute failure with peripheral relaxation, other remedies, now to be described, are more efficient. If, in spite of the remedies already mentioned, the heart is getting more poisoned and feebler, how are we to proceed? Digitalis, I have said, although not to be set aside altogether, is not very trustworthy in a deteriorated heart, especially if there be notable pyrexia. To digitalis I prefer caffein, but the

present set of opinion is rather in favor of theobromin; of this drug my experience is less; so far I do not think it equal to caffein, though it may have less tendency to cause insomnia. I always use the "caffeina pura," of which my experience has been large and satisfactory; the citrate, if more convenient, is less stable and, in commercial samples, less trustworthy. The pure caffein is, unfortunately, not very soluble; but to patients old enough to manage them it is easily given in capsules; and to judge by its effects the alkaloid seems to pass quickly into the system. For children, unable to swallow capsules, it may be dissolved in the salicylate mixture, if these salts are given; or it may be placed on the tongue with a little milk-sugar or syrup, or a strong decoction of coffee may be given, hot or iced, by the mouth or inserted warm into the rectum, or again, the compound called diuretin. Of the alkaloid a grain may be given every hour to an adult; to a child proportionally less. Of the subcutaneous use of it I have little experience. For children theobromin seems to offer no advantages; it is almost as insoluble as caffein and the dose is larger. In adults suffering from cardiac diseases we may give as much as 15 gr. of theobromin for a dose; in acute rheumatic carditis in a child I should begin with 1 gr. By virtue perhaps of its xanthin constituents, good home-made beef-tea acts after a similar manner; here, again, clinical experience bids us, unless under peculiar circumstances, not to discard on abstract notions a remedy, whether food or drug it matters not, which has commended itself to many generations both of physicians and patients. The drawback of caffein is, in some persons, its effect of insomnia. It is advisable, therefore, not to administer it toward evening; but in many patients this effect does not show itself, or it does not prevail against the slumber of alleviated suffering.

Saline laxatives are to be avoided in myocarditis, and a mild blue pill, castor oil, or a gentle electuary of sulphur, tamarind, etc., is to be preferred.

If, with temperatures of 102° F. and upward, delirium appears or increases, with tendon jerks and other evidences of toxic fever, and there be no considerable signs of collapse, such as cold extremities, sweat, and pallor of the surface, antipyretic measures of some kind are too imperative to be set aside on the apprehension of throwing more stress upon the heart. Although the treatment of rheumatic hyperpyrexia does not fall directly within the confines of our subject, yet it is well to consider if a sudden peripheral constriction may be too trying to the heart. From the cardiac point of view graduated cool to cold bathing—sponging is rarely effectual—is to be preferred to agents of the antipyretic group, some of which are known to threaten the heart. In diphtheric and septicemic carditis we may desire likewise to avoid sudden elevations of arterial pressure, even such as we may disregard in most cases of enteric fever, attended, as it is, with some cardiac impairment. Thus, if the symptoms I have indicated appear, cold baths would probably be perilous, and we must be content to sponge the arms and legs with tepid water; and by degrees, especially if by less dicrotism of pulse and

a fall of temperature we are encouraged to proceed, the whole body may be sponged with cooler and cooler water, and the bedclothes so raised upon a cradle as to admit of gradual radiation and diffusion. If extensive areas of vasomotor constriction should raise the blood-pressure and so throw more work on the cardiac systole, on the other hand, as the "typhoid" state is attended with widespread vasomotor paresis, a toning up of the vessels in cutaneous areas may compensate expansion in splanchnic areas; so that, if the commencement of cooling be made as gradual as possible, the stress on the heart even at first may be insignificant, and, on the whole, no more, while the blood may be better distributed, and the tone of the vascular system braced up, I have never seen reason to suppose that visceral congestions, as in liver or lungs, were produced or aggravated by raising the tone of the peripheral arteries. To correlate rises and falls in areas with the general blood-pressure often needs much discernment. It is our duty in therapeutics to lay as broad a foundation of physiology as the state of our knowledge permits, but we shall rely mainly, nevertheless, on clinical observation, and not be deterred by apparent physiologic contradictions from taking such steps as clinical experience seems to justify.

In many of the cases now under our notice the disposition to peripheral vasomotor paresis, and therewith to a leakage of blood into the venous reservoirs, is very evident; in this condition to spur up an empty left ventricle can never be a rational practice, but an ice-bag to the abdomen and elevation of the foot of the bed may counteract this paresis, and the heart may be benefited by some return toward a normal loading. We shall see hereafter that even in the intrinsically feeble and degenerate hearts of chronic disease a rise of general arterial pressure may relieve the heart and circulation very notably; for some return toward the normal loading of the muscle, so far from impairing the heart, often calls out its reserve energy to permanent advantage. If by vasoconstriction we can hold back some of the blood in the left ventricle and thus make its load more adequate, and call forth more energy, we shall keep more blood in the cardiac and vasomotor centers and in the coronaries. The pituitary extract seems to offer some badly needed help in these conditions, especially in low-pressure cases, as in typhoid, influenza, etc. If we are in doubt as to the bearing of these mechanical factors we may test the effect on the heart and pulse of compressing the abdominal vessels, including the aorta itself, or by bandaging the limbs. If, by such means, and other features of the case, we believe we have to do with collapse rather than with dissolution of the heart itself, we may go still further and make use of saline injections by the rectal and subcutaneous methods. Again, we must discriminate between the recoil of an artery upon a waning content, as in falling pressures, and the constriction of increasing tone. In the earlier stages of infection the heart is probably not the culprit; it is to the later stages that these considerations apply.

Similar considerations apply to the administration of strychnin, if the heart is yielding under toxic influences. We are told by the ex-

perimenter that, if for a moment this drug arouses the heart, it does so by such a stimulation of the center in the bulb that this is but the sooner exhausted, and then we shall find ourselves worse off than before. I can scarcely think that this apprehension will discourage the physician, who has watched the effects of strychnin at the bedside, from relying upon it, even heavily, in these cases; the success of the drug is too notable, and even a more or less continuous use of it too evidently effectual, for us to be too timid lest we jeopardize the central resources by extravagance. For there is no more direct way of exhausting the bulb than to expose it to a fall of arterial pressure. In the effects of vaccines we see how latent resources may be called forth and realized at need. At the same time, although we shall not forego a means of succoring the heart which seems both effective and justifiable, yet we shall not forget to watch the results vigilantly, lest some degree of overstimulation be reached. All observers seem agreed, however, that the bulbar centers have more tenacity than was supposed. There are, no doubt, some differences to be observed between the uses of strychnin in a comparatively sound heart failing under external stresses and in a heart yielding to intrinsic fault; but they are not yet so far understood as to help us much at present. If it be true that for any solid repair strychnin may be impotent, yet fleeting and unsubstantial are all the aids to be drawn from the pharmacopeia in such crisis, and a gentle touch of the hand may enable a tottering patient to cross the narrow bridge in safety. As yet, then, we must be content to use the drug tentatively, noting in each case the indications for pushing or withholding it; for instance, the state of the knee jerks may be noted from time to time. Thirty to sixty minims of the liquor strychninæ (B. P.) per diem, by the skin, are no unusual quantities in adult cases. If it be given subcutaneously, and not in routine doses, it may be pressed at moments of peril even till facial twitching is perceptible. The ear must be kept on the heart, and, if practicable, the manometer should be at work also.

In symptoms indicative of collapse we have another valuable means in injections of saline solution into the bowel, or subcutaneously. There is no great advantage in transfusion by a vein, a difficult method in all patients, and in children peculiarly so.

Agents which must be injected into a vein cannot become generally useful. Of such are adrenalin, strophanthin (see p. 81), and pituitary extract. This extract is far more lasting in its vasoconstricting effects than adrenalin. It is said not to lose its efficacy when injected hypodermically, with normal saline solution, or into the rectum; but the dose will certainly need frequent repetition.

In some cases even of myocarditis with pyrexia when there are increased transverse dulness and cardiac irregularity with acceleration, digitalis is not to be wholly neglected; if tried, it should be as one of the glucosids, in cautious doses.

On the general treatment of the morbid process upon which the cardiac intoxication depends, I must not enter at any greater length;

to do so would be to travel outside the subject of this section. In passing, however, I must insist again in diphtheria upon the use of the antitoxin at the earliest possible moment, to anticipate, if possible, the closer union of the toxin with the organic molecules of the cardiac, nervous, and other tissues. I need not use space in reminding the reader of such popular cordials as ether and ammonia and the like, useful in phases of syncope or exhaustion; but they are temporary restoratives rather than enduring supports. I should add that the subcutaneous administration of ether and alcohol, unless in some extremity, is undesirable; local sores may arise, and there are better ways of compassing our ends. Of the large doses of camphor, used by some physicians in heart failure, I have no personal experience; indeed, I should be a little timorous of giving it in the doses, from 5 even to 20 gr., recommended by some authors. Nevertheless, the drug is well spoken of as a cardiac restorative, and much of this testimony is by physicians whose opinion is not to be overlooked (see p. 90). To oxygen I have referred already. It is a good practice in these cases to administer one of the cordial drugs, or a little caffein, before any unavoidable effort, such as the action of the bowels or change of position in bed. Absolute rest, even to feeding by the nurse, must be enjoined so long as any considerable signs of dilatation remain; but in ordinary cases, in a fortnight or three weeks, these will have much diminished.

The obscure but perilous conditions of clot, of fixed or traveling clot, cannot be altogether omitted; yet of these treatment seems scarcely possible. In infective endocarditis, in typhoid fever, in pneumonia, in scarlet fever, in mitral stenosis, in every disease in which clot is to be feared, we are told to be careful in respect of the ingestion of calcic salts (*e.g.*, much milk), and to see that ammonia is administered somewhat freely. Although these allegations concerning the lime salts are very far from being verified as yet, it is our duty to pay some heed to them. In my experience, as regards the limbs, it is far more important to take care that neither leg lie on its fellow, nor arm or leg be subjected to any kind of local pressure. As regards the heart, to keep the blood moving in the auricles will, of course, be one main purpose of all our cardiotherapeutic measures. If, however, a sudden attack of dyspnea or hemoptysis proclaims the entry of a clot into the lung, the patient must be propped up in bed, $\frac{1}{8}$ to $\frac{1}{6}$ gr. of morphin injected under the skin, and the oxygen apparatus put to work. In some extreme cases, I have gently assisted the respiration artificially with advantage. No alcoholic stimulant is to be given; indeed, the less medicine the better, unless, of course, the heart begins to fail, when the appropriate means will be used which have been discussed already.

As convalescence advances, treatment returns within ordinary lines, which I need not indicate here. I may, however, refer to Prunus virginiana, which some thirty or more years ago I recommended in heart affections, both functional and organic; for I note, from time to time in the medical journals, that physicians are still making use of it.

I have never seen reason to desist from the use of this drug as one of the milder cardiac "tonics and calmatives." In lesser degrees of the cardiac weakness of acute disease, and after the crisis is past, as well as in more chronic maladies, I find it, in doses of 30 to 60 minims of the tincture, a valuable if subordinate agent. Moreover, it is a pleasant and soothing drug to a queasy stomach.

I cannot leave this section without a reference to a class of obscure, but very intractable cases, which proceed by stealthy steps, so stealthy as to deceive us until the mischief is done. The cases to which I refer are cardiac degenerations, often of a virulence ultimately lethal, which appear occasionally in early middle life, for instance, at thirty to forty years of age, when, in persons of healthy constitution and regular habits, intrinsic decay would not be anticipated; for these cases may be of the same nature as the toxic processes which terminate more rapidly. Such a patient will complain of the accession of dyspnea on slight exertion, and dilatation, generally of the left ventricle, loss of systolic tone, etc., may be discovered; or the physical signs may be negative or equivocal. These events probably depend on some latent or unnoted infection, and only too often, as I have said, prove at length incurable. In the course of months, or perhaps a year or two, the heart affection may end in recovery; but more usually it ends in death by syncope rather than by pulmonary and hepatic congestions and dropsy. While he seems for the time to be making some slow but substantial amendment, the patient may die suddenly. The treatment of such cases, in so far as it is not covered by what has already been said, will be dealt with under Chronic Heart Failure.

A few sentences must be devoted especially to the later stages of the treatment of *the influenzal heart.* We have seen that severe cardiac poisoning in influenza may be contrasted with that in diphtheria in this respect, that while in diphtheria symptoms are often latent, signs equivocal, and death—in apparent convalescence perhaps—sudden and unexpected, in influenza signs and symptoms are usually obtrusive, distressing for the patient, and for the physician very baffling and unruly. In influenza we may surmise that the cause of derangement may lie not so much in defect of the muscle as of the nervous endowments of the heart. We may thus have to explain how it is that "cardiac tonics," and strophanthus in particular, have, as a rule, so much better an effect upon the heart during the attack itself, when the pulse is often retarded, than later in cardiac symptoms appearing after the first ten or fourteen days. At the same time it must be understood that the chambers of the heart are nearly always altered, often gravely so; and usually in the directions of dilatation, whether this atony be due to nervous paresis or to coincident muscular intoxication. Although the dilatation may appear suddenly to the left side or to the right, with pallor or cyanosis, and with nausea or even vomiting, the subsequent reluctance and tenacity of these cases create a serious dilemma. To confine a young person absolutely to bed for weeks upon weeks is not only to impose a very tedious rule, but one not without many

drawbacks, physical and moral. And yet every attempt to wean the patient from rest, to set him on his feet, aggravates the disorder; the rhythm of the heart, disturbed as it is, gets worse, and the quick, irregular, undulatory, and diffuse impulse of dilatation becomes more aggravated, with a variable systolic murmur and, subjectively, with palpitation and more vague distresses. In some cases, it is true, the heart is not much enlarged, and it may be hard to say why not. Perhaps it depends upon the state of the periphery. In these straits the patient must rely on the discretion of his physician, who will gradually temper rest with the tests of gentle manual exercises. Even after a pneumococcic pneumonia or a catarrhal infection, if the heart has been disturbed, convalescence must be initiated tentatively. We shall often have to ask ourselves when a bolder course may, on the whole, be justifiable; when, if indeed as a mere machine the heart be rather more troublesome for a time, yet for the patient to be out of bed and quietly occupied, and to enjoy fresh air and the diversions of society, may have a tonic, restorative, and in many ways wholesome influence, counteracting introspection, deterioration of habits, and the interruption of discipline and business. Yet too far a trespass upon the toleration of the heart menaces harm; a day's indiscretion may be followed by a prolongation of that very imprisonment which we are so anxious to abbreviate. In these cases the factor of gastric extension, so troublesome also after acute rheumatism, often adds to our perplexities, and a careful regulation of diet (see p. 118) is needful, not only in respect of the hampered mode of life, but also of the restoration of the tone of the stomach.

As, in the cases we are discussing, pyrexia has long passed away, we are better able tentatively to use digitalis; and by this drug, in combination perhaps with quinin (as described on p. 70), by strophanthus, diuretin, prunus virginiana, cactus, strychnin, iron, and other proper means which the indications may dictate, we may endeavor to hasten the dilatory process of nature. A few grains (5 to 10) of chloralamid act well in moderating a tumultuous heart. Empirically, I find advantage in a combination of chloralamid with a few drops of tincture of belladonna in spirits of acacia. Sometimes, often indeed when disturbance of the vagus seems predominant, atropin or arsenic may be helpful; atropin especially when it would seem that the vagus is under irritation. Diuretics, diaphoretics, courses of hepatic stimulants, etc., are incidentally called for; but occasionally the cardiac affection does not, as in ordinary cases, act very perversely on the distribution of the blood. So long as the patient lies still, the heart does what is wanted; if it does it clumsily and tumultuously. Happily, these cases do not end suddenly, nor, indeed, prove fatal ultimately; at any rate, no such misfortune has happened within my own definite knowledge; yet these influenzal hearts are, or a few years ago were, only too frequent. One case I remember in which influenzic neuritis attacked—as it would seem—both phrenic and vagus nerves, and death by palsy of respiration ensued within ten or fourteen days after the commencement of the attack. In this and such cases medicine is, as yet, impotent. As in

recovery from diphtheric heart, bitter and ferruginous tonics are contributory to amendment. For convalescence there is no remedial means like life in the open air by the sea.

Chronic Diseases of the Heart

Chronic Valvular Disease.—When by a convenient and practical distinction we pass from acute diseases to consider severally the chronic diseases of the heart, we are wont to make certain further distinctions—to distinguish chronic valvular from chronic degenerative diseases, and again to divide the valvular diseases according to the particular valve, or valves, in defect. The danger of such divisions, necessary as they may be, is lest we divide too absolutely; lest we forget that in certain aspects these maladies fuse together; and, indeed, that no important part of the heart can be in fault without its effects being felt in each and all other parts of the organ. We shall not fix our eyes too narrowly upon "types" of heart disease, but in each case we shall estimate carefully, first, the distributions of pressures between the arterial and venous sides, and these again in the districts within each of these sides of the circulation; secondly, the causes of a faulty distribution. In practice we can broadly divide these causes into the mechanical—chronic valvular disease—and the vital—chronic myocardial disease; the former being characteristic rather of persons under middle age, the latter, whether with or without valvular disease, rather of elderly persons. We shall deal first with the valvular faults, remembering that as the heart loses its specific energy the circulation falls more and more under the dominion of mechanical conditions, and our remedial methods become modified accordingly.

Before entering upon the details of the several valvular diseases in respect of therapeutic principles, it is convenient to discuss certain features common to all of them, or at any rate apt to arise in any of them. The chief of these are readjustment, dilatation, degeneration. Readaptation, or "compensation," is perhaps the most important of the modern conceptions which govern the therapeutics of mechanical as contrasted with degenerative disease of the heart. Readaptation is the change of the statical relations of the parts of the heart in correspondence with some change in the mechanical conditions. It consists most conspicuously and importantly in partial enlargements. Even for physicians before the days of Laënnec heart disease during its latent stages was no disease. In these stages the physicians of that day had not, and could scarcely have had, any adequate indications of its kind or even of its existence. Yet it is a curious instance of the proverb, that men only see what they are prepared to see, that, although there are indeed many physical signs of chronic heart diseases needing neither pleximeter nor stethoscope to reveal them, yet these, obvious as are some of them to eye or hand, remained unnoted until, educated by the stethoscope, our fathers learned to see and to interpret visible or palpable signs for which before they had no perception. For them heart disease did not begin

till the heart was giving way; until it entered on its latter and decadent phases. And, even then, dropsical and pulmonary congestions were not attributed, could not, perhaps, be attributed accurately, to their true causes; for before the era of Bright, heart diseases were so inextricably mixed up with diseases of the kidney and liver that continuous confusion was unavoidable.

The "compensation," for instance, of aortic regurgitation by a muscular hypertrophy might have been perceived more adequately before the interpretations of auscultation and percussion were available, although it could not have been very accurately valued, promoted, or moderated. And even to-day, in using the term "compensation" in heart disease, we are not always careful to signify no more than, in the nature of the particular case, is required. No large imagination is required to reveal to us that readjustment must be a very wide affair, extending to the extreme peripheries and issues, not of the circulatory system only. We are prone to attach to the term "compensation" some notion of intervention, of device prearranged by the agency of Nature, as the "motorist" provides a spare tire in his car. Now, compensation in cardiac disease is no more than that gradually acquired capacity of any fairly stable moving equilibrium by which it has developed and survived, and by which it maintains itself. As in virtue of such continual readaptations it has become more complex, so it presents more defences against interferences. If by past adaptations against certain events a power of accommodation has been acquired, stability is maintained; if not, it fails. These perpetuated readjustments, by which organisms survive and propagate themselves, are, by no means mechanical only; for instance, the responses of "antibodies," by which perturbations by incident poisons are neutralized, are "compensations." But we must analyze the functions without imputing to them any end outside themselves. Compensation is not then quite so good a word as readjustment.

Readjustment, or Readaptation.—If then the organism can readjust itself to changed conditions or incident forces it will persist, but we are not to interpret this readjustment as compensatory in a metaphoric or teleologic sense. An active muscle brings about an enlargement of the bone or part of bone to which it is attached, but it would not be free from fallacy to speak of this as "compensation"; indeed, in this meaning, as in the sphere of immunity, we do not use the word. Nor is this a matter of words only; a notion is subtly implied of some natural provision of compensation as such, which leads the student of disease or injury to expect interventions; to expect "nature" to put a dab of mortar in this breach or in that merely because it is wanted. The truth is that as hearts in all past time, and all animals with hearts, have been continually readjusting themselves, so in adversity the organ has become so highly differentiated that it contains unsuspected resources. All readjustments, counteractions, accommodations, and protections in the faulty heart are, then, but manifestations of autonomic, even endonomic, capacities more or less continually at work in the conserva-

tion of health. We cannot expect to bring to bear any bystanding agency, to use trowel or prop, to fill a hole in a valve or to shore up an arterial wall. In every athlete the heart—as we now believe—waxes somewhat; the muscle of the circulation does as do other muscles of the body—it grows uniformly in all its parts. The well-known researches of Hirsch seem to show, indeed, that the cardiac muscle maintains a definite proportion to the mass of the skeletal muscular system; and my own observations indicate that its capacity for hypertrophy is confined within the same constructional scheme. But for the heart to carry forward this normal readjustment in exceptional degree, and in particular parcels, so as to counteract a defect in some associated part, if in principle the same process, is not so simple and effective a process. The inherent difficulties in partial readaptations are obvious. There is no definite evidence, indeed, that the muscular fiber of these partial and occasional hypertrophies is not intrinsically as good, and in itself as durable, as the cardiac muscle of ordinary conditions. The alleged intrinsic inferiority of such partial and provisional muscular development rests on no more than surmise. Experiment cannot compass these slow and subtle natural processes, but the effects of experimental injury —to the aortic valve, let us say—show, in the main, that by cardiomotor resources, inherent and reflex, an extraordinary accomodative power of the heart grows up: as any skeletal muscle grows up on setting it to new lines and degrees of work. The cardiac muscle does but follow the law of the biceps. The latent reserve of the skeletal muscles we see in the strength of the maniac, or we feel in an attack of cramp; and in the added labor of the heart the added muscular volume may be as good and as free from callosities as that of normal function, as has been shown in long-standing hypertrophies by Kanthack and myself, by Bollinger (in Pettenkofer's Festschrift), and others. If this hypertrophy were but a temporary shift the therapeutist would lose much of his confidence. I have now under my care a man in whose heart no inconsiderable aortic regurgitation was recognized more than twenty years ago, and with it an equivalent hypertrophy of the left ventricle; for twenty years I have watched his heart for him. He lives a free and useful life, guarded only by a few obvious precautions; he cycles about, walks on all ordinary hills, and remains in as good health as his neighbors. In all these years his heart has betrayed no deterioration, and he is now passing beyond the term of "middle age." This does not look like inferior material in the added muscle, or as if "hypertrophy were provided out of the cardiac reserves," with a reduction by so much of the potential energy of this tissue. There are conditions, no doubt, against its endurance, yet they lie not in intrinsic defect, nor in conversion of latent energy into structure, but in the less stable and disproportionate conditions with which it is almost necessarily associated. As in aortic regurgitation, for example, the aorta begins to suffer under the abnormal stresses, an atheroma will begin, and may occupy the mouths of the coronary arteries; or, to take another case, as the mitral orifice contracts in stenosis

the lungs and the aëration of the blood suffer, the blood deteriorates, and the increasing nutritive demands of the muscle of the right ventricle are not supplied; or, once more, as in Bright's disease the kidney gets worse and worse and the peripheral resistance more and more intolerable, the blood supplied to the left ventricle is becoming less and less wholesome; and so on. Yet even when fibrous callosities have formed, suggestive as they are of deterioration, the muscle is still compatible with a useful and effective ventricle.

Still it must be admitted that the new muscle is not always good, not even in the beginning of the readjustments. In such patients as those to whom I have just made reference it is usually good; in them the lesions were probably instituted very gradually, and the heart had time to grow before its molecular constitution was perverted. In such a case the vital property of tone is usually sufficient from the outset to protect it against stresses beyond its elastic limits; the new tax is levied very gradually, and with time is well paid. But this is by no means always the case; things often go harder with the ventricle. Referring again to aortic regurgitation, let us suppose a case of acute rheumatism, or of injury, in which a considerable regurgitation takes place more quickly than the energy of the ventricle can rise to meet the excessive demand: the tone of the heart may be fairly good, even very good; it utilizes its "reserve capacity"; it strives day and night against the extravagant pressures; it keeps up the arterial head by accelerating its speed, but at the cost of its diastolic rests; and indeed in the large majority of cases the burden somehow gets readjusted, and the heart gets more on a level with its work. But, as in a "fatigued" iron rail, the excessive stress will have left its marks. By molecular and intercellular tensions and shears at the time of extraordinary stress irreparable damage was done, although, by a process which in biology we call "subinflammatory" change, another kind of "compensation" may make some partial repair of it. Thus, even in young persons, if the stress were heavy and sudden, or in older persons if the supplementary growth were less vigorous, the repaired parts may contain material of less value than the normal muscular fiber. Under histologic examination Kanthack and I noted that the cardiac muscle loses its uniformity; between the normal muscular fibers lie others of less value, substituted fibers having no claim to be called muscular at all. Some value as braces they probably have, but no contraction value, no conductivity, and little vital tone. But we failed to verify any proportion between these fibrous changes and heart failure. They were often evidently of very long standing, and showed no recent signs of deterioration. Their extent, again, was very capricious and stood in no practical proportion to the heart's efficiency. In some of our cases, as in three cases of extreme atheromatous aortic stenosis in old subjects, no fault could be found with the large and powerful muscle—powerful because, to keep the circulation going, it must have driven the blood through the minute orifice at an enormous velocity to keep up even the moderate head of arterial pressure required for senile existence.

A careful research, carried out in our laboratories by Dr. Gutch, demonstrated that in very young subjects hypertrophy of the cardiac muscle may consist to some degree in added muscular cells, but that this multiplying faculty is soon lost; generally speaking, muscular hypertrophy consists not in increase of the number but of the size of the cells: added fibers, if any, are those of the inferior kind of which I have just spoken.

How, then, are we to promote the enlargement of the muscular cells when greater energy is needed? Krehl has done some work in illumination of this problem, and it would seem that, as the reserve capacity of the heart is called forth, and thereby the velocity of blood in the coronary arteries increased, intracellular tension increases also. No doubt, activity of nutrition and growth must depend, at bottom, on tissue appetite and assimilation; but probably tissue appetite is not always indulged to its utmost, and experiment has proved that many tissues, at any rate, such as the combs of cocks, can consume more if more be allotted to them. But in the more elaborated organs mere profusion of blood supply is probably insufficient to promote more abundant consumption; besides the more liberal supply, there must be some general encouragement, probably some release of the nervous escapements, and the so-called "cardiac reserve" may consist, in part, in some such release; but the mode and sources of the reserve are as yet very obscure. I suspect that its resources lie chiefly in the hyaloplasm which accumulates beyond the instant and current rates of conversion. We have noted, however, that reserves are by no means confined to cardiac capacity, but are practically universal; that only by such reciprocations can the play of our several organs mark the incessant variations of time and demand. Reserve is called upon not only, as we have seen, in the case of most intercurrent disease, but also in any and every adaptation to the incessant fluctuations of ordinary life. Without large variations in the reciprocative functions of its several parts the body could not go on. The principles of therapeutics, therefore, consist largely in calling out these reserves, in an encouragement of the appetites of the cells, and the delivery of larger supplies of good blood to them; and if the demand continues other changes proceed—the changes of Krehl. In these changes, described by Krehl as an increase of intracellular tension, the particles within the muscle-cell are urged apart, a larger quantity of plastic elements enters into the cell and distends it, and by this enrichment and separation of constituent particles the cell itself is enlarged, and may be enlarged permanently. Such, then, seem to be the relations in the heart between ordinary work, reserve capacity, and hypertrophy; provisions which are not introduced by nature as a peculiar machinery to counteract a particular disease, but are an application of functions and capacities continually active and conspicuous in the interchanges of ordinary physiologic life. Now in disease they become the basis of the physiologic therapeutics of which the cardiac exercises of Oertel and Schott are but conspicuous examples.

In chronic valvular disease, then, the therapeutist has to consider

whether the case before him be one in which "compensation" can be promoted or not; whether the sound parts can readjust themselves to the new conditions, or partially, or not at all. We have taken aortic insufficiency as a classical example of remedial compensation; in the degenerate heart, however, compensation hardly finds a place; if the worm be at the root no readjustments seems practicable; the cure, if there be a cure, must consist in some more radical influence. Yet as it is true that, in the cases of mechanical fault also, dilatation and degeneration may enter in and thwart our plan of treatment; so in our treatment of the cases of both classes there is often some community of method and purpose. In the one muscular failure may menace us, in the other an overtaxed heart may reveal more recreative power than we anticipated. In both, the first thing for us to do is to estimate not only the degree of damage but also the means of nutrition. If adequate factors of nutrition be granted, there seems, as we have said, to be no narrow limit to the capacity of the muscular parts of the heart to increase or amend; but we have seen also that, although in hypertrophy the cardiac muscle is thus capacious, yet as it becomes stronger and heavier the more it transcends the scale even of healthy associated parts; and that this is the chief reason why such readjustments have not the permanence of a normal adjustment. A big, vehement left ventricle, for instance, racks the machine; especially it belabors and injures the aorta. This vessel and parts still more delicate, though in their degrees they may take on some increase also, yet cannot grow as the heart may grow; it is doubtful, indeed, whether the large vessels, which are more exposed to strain and are relatively poor in muscular tissue, can take on much defensive increase of normal elements. We have remarked that as the aorta becomes the seat of atheroma, the coronary arteries or their orifices are liable to be involved in it. Also, that in granular kidney the huge hypertrophy fails because, while the blood is deteriorating, the peripheral resistance is ever on the increase. In diseases of the mitral valve, again, the lungs, whose vessels are unprotected by vasomotor tone, suffer when thus subjected to the unusual and protracted stress of a bigger left ventricle; they become, as von Basch says, swollen and stiff with congestion, perhaps from the beginning; and so the respiratory pump is shortened in its stroke, and the pulmonary vessels, losing elasticity, ere long in chronic inflammatory and degenerative changes reveal the effects of strain. In mitral stenosis one of the earliest effects of a bigger right ventricle is a cough which, a winter cough at first, stealthily gains upon the patient, creeps round the year, and is apt to be attended, even from the early stages, with hemoptysis. Although, then, we must encourage hypertrophic compensation, we have to remember, when the demands on the reserve strength of the heart are extortionate, at what cost it is carried out; and the therapeutist must try, as far as possible, in mitral disease to protect the lungs, in aortic disease to protect the aorta, from the secondary effects of abnormal stresses which, in aorta and pulmonary artery alike, become evident in loss of elasticity and in chronic degeneration of the walls.

Again, as there is a period in the reaction of the heart under valvular lesion when compensation is to come, but is not statically realized, so, likewise, are there many periods during the subsequent course of such maladies when compensation, although temporarily attained, is overborne by some incident, the circulation being for this interval the scene of almost unmitigated disorder. It is obvious, then, that in heart disease methods of treatment cannot be the same during times of perturbation and during times of fair, if artificial, stability. We have remarked that heart disease is by no means altogether a matter of static forms, but is also one of continual dynamic fluctuations, chiefly perhaps of vasomotor origin. From the flurries to which the soundest heart is liable we cannot expect the diseased heart to be free. In many cases of heart disease there is a functional fringe of symptoms to be cleared away. There cannot, then, for each nominal disease of the heart, be one rule of treatment, to hold good for all its various phases; if it be true, as we set out with assuming, that each has in a broad way its general indications and main features to guide us, yet our methods must at any rate be very elastic if not very diverse and mutable. Means which may be efficient during states of stability of the circulation, periods when, as Potain has said, therapeutics give place to hygiene, during more disorderly phases may be quite inappropriate.

Dilatation is implied in almost every hypertrophic readjustment; generally speaking, the chamber has to hold more blood and to propel more blood. But when we speak of dilatation as a defect we mean rather a degree of extension of the diameter of a chamber which exceeds the normal proportion between that diameter and the quantity of its efficient muscular energy. We may find, for instance, in auricle or ventricle, especially in the auricle, the capacity of which for hypertrophy is but small, a simple dilatation, a dilatation that is without any notable muscular increase; and if in chronic disease, as we have just said, some increase of muscular power is often obtained also, it may be far from attaining the degree required to counteract the mechanical disadvantage of increasing cubic capacity. Between the capable left ventricle, which has to meet a vast range of variation in the pressures and distribution of the systemic blood, and the small range and capacity of the auricles, comes the right ventricle with its relatively even work and freedom from phases of variable distribution, and consequently with some less capacity for hypertrophy and some greater liability to dilatation.

Dilatation is usually due either to a rate of increase of internal pressure exceeding the possible rate of supernutrition, or to a morbid defect in the nutritive resources of the heart or of its circulation whereby, however slowly the internal stress may become excessive, it is disabled from adding much or anything to its muscular strength. Its blood may be poor or vicious, its vessels may be perishing, or its parenchyma may be losing its natural avidity; or such factors may coexist in variable combination. The treatment of dilatation, if relatively excessive, must take into account excessive blood-pressures within the chamber or chambers concerned, excess in the mean volumes

of the blood to be lifted even at normal pressures, or failing power in a flaccid or perishing muscular wall under normal, or even subnormal, pressures and volumes; and these, severally or collectively, as the case may be.

Before we can undertake then to treat a case scientifically we must have some means of computing these factors, and especially the third of them —degeneration. Excessive stresses we may be able to reduce quickly, as by rest, diet, or depletions; excessive volumes also may be moderated; but to reinvigorate a declining muscle can never be a ready or easy achievement, even if, with time and pains, practicable. How shall we calculate this factor when, by moderation of the functional conditions, we have made them as favorable to the heart as possible; for among many variables the coefficient which most deeply concerns us in all cases of chronic heart disease is dynamic—the power of the cardiac muscle itself. For instance, a person of some fifty-five years of age falls into an acute dyspnea with some anasarca. The action of the heart is quick and irregular, and the pulse poor in volume and tone—a well-marked "mitral pulse." As more complete beats allow the cardiac sounds to be defined a soft systolic murmur is perceived at the apex. Now, is this state of things to be attributed to a recent and increasing decay in a prematurely enfeebled heart, or is it the revelation under a slow accumulation of stresses of a long-existing valvular defect? Much will depend on a right answer to this problem. If the facts point to the encroachment of senile decay of the myocardium death cannot be long averted; if to a defective valve in a wearied but still fairly well-nourished heart, if its debts can be paid, and it can be started again in a smaller way of business and under a better nursing of its diminished capital, it may still perhaps be capable of recovery. Now on further enquiry it may appear that in the previous winter the supposed patient had begun to suffer from bronchitis, attributable to a slower cardiopulmonary circulation. Further enquiries bring out the fact that when at school he had rheumatic fever. On such a story as this we assume a valvular defect of long standing and a cardiac muscle which had been good enough to serve the needs of an active life for many a year. Moreover, the valvular defect may prove to be not very great, so that if the heart can have rest and time, and the demands upon it in the future can be economized, it may get along fairly well for some years to come. In this case, by careful and gradual unloading of the pulmonary and abdominal areas, by use of occasional sedatives to procure rest in bed and some fair sleep in partial or complete recumbency, the influence of cardiac tonics may be brought to bear, and we may obtain from a substantially sound but overwrought cardiac muscle no unsatisfactory response. Every physician has witnessed surprising amendments of this kind. If, on the other hand, the heart were failing from intrinsic decay, digitalis, our faithful and strong but sometimes too exacting ally, might make things worse rather than better. Nor in such a case might strophanthus give us much more help than digitalis. Pituitary extract is said to be of more

use. In these degenerative cases we are face to face, not with critical moments of stress and arrear, but with demolition. Bulging walls may be shored up, but walls that are crumbling away present a less hopeful problem. By mechanical rest and redistribution of load we take the weight off and bring the work down to the lowest terms, but only too soon the intrinsic weakness becomes more and more manifest. How, then, are we to try to measure the degree of response of which the heart is capable? In appropriate cases we may compare the jugular and carotid curves and their time relations, as practised by James Mackenzie, and we shall make the clinical observations suggested below, but the labor test—if I may use such a phrase—should give us the most direct and useful information.

Cardiac Tests.—It is not the least of the advantages of therapeutic exercises that they serve as a test of the capacity of a particular patient, and of the variations of his cardiac energy at various times and under various conditions. For this purpose exercises are more convenient than baths; and a Zander machine, if available, better than the less definite reckonings of an attendant: although in most cases this procedure will do well enough for the occasional observations now under consideration. The method consists in the provocation of a fairly known certain amount of effort against resistance—of the degree of which a practised attendant will be no very fallible judge—and the comparative rate of the patient's recovery time. Herz uses simple flexions and extensions of the arm. These tests are useful, and rough estimates of the state of the cardiac muscle after infections (see p. 44), or in the suspected degenerations of later life. A good rate of regain indicates some temporary disorder of the circulation or disease elsewhere, rather than fault in the heart itself. Thus, broadly looked at, we might infer the time when, after such an infection as diphtheria, more liberty may be granted to the convalescent; thus also nervous or other functional perturbations might be distinguished, or some definite advice given to elderly men who enquire of us what limits it would be wise to impose upon bodily exertions. But we cannot rely much on such signs, not even on arrhythmia; essentially muscular as is cardiac work in its source yet it is implicated in nervous and visceral connections by way of which, especially in certain temperaments, contingent variables may assert themselves.

James Mackenzie proposes as a test to note minutely at the stopping pressure of the manometer how many beats are arrested and how many may push through.

Another test of cardiac value is described by Katzenstein,[1] and is said to be effective, but it is too unpleasant for general use. If on compressing both femoral arteries the arterial pressure rises, say some 15 mm., and the pulse rate does not rise, or even slows a little, the heart is vigorous. Or even if the pressure does not rise, if the pulse is constant the reaction is fair. But if pressure falls and the pulse rises in

[1] Deutsche med. Woch., No. 25, 1904.

rate the heart is insufficient, and our treatment must be regulated accordingly.

A fourth test is the difference of pulse between standing and lying, a difference which in health is 7 to 15 beats per minute, but diminishes or is lost in cardiac dilatation; if after a short course of digitalis this difference began to return the prognosis would be so far good. But in those earlier phases in which we especially need this information the test is too indefinite to be very trustworthy. A fifth test is the maintenance of the strength of the pulse on raising the arm from the dependent to the vertical position, and how the veins on the hand and arm empty themselves; but here vasomotor conditions come into play. Trigeminal irritation (*e. g.*, smelling salts) slows the normal heart at first. The digitails test is mentioned on p. 67. If by abdominal massage the vasomotor tone be raised and yet peripheral pressures are not enhanced, frailty of the heart may be suspected. Graupner's test,[1] which has been verified by Cabot and Bruce,[2] and which has been again carefully investigated in our own laboratories by Dr. Searle, depends on a comparison of the behaviors of the pulse rate and the arterial pressures after an effort. In the normal heart under exercise the systolic pressure rises after the acceleration of the rate, and on rest is maintained longer; in the impaired heart the pressure rise is at best delayed and diminished; hearts gravely impaired cannot carry the pressure up at all, indeed it may even sink, and recover itself slowly. Searle's research on healthy students and hospital patients establishes the test as effective, and in cases of suspected hearts with negative signs, very valuable; but two observers are necessary, and it takes too long a time for common use. Much time is consumed in allowing for excitement, for recumbencies, and so forth. Moreover, in doubtful cases the question of the individual standard comes in; of age also and elastic quality of vessels. Searle found it unnecessary to calculate the work factor in foot-pounds; the degree of dyspnea set up by the work was of more importance, and the kind of work done. It is, however, the best test we have, and will be resorted to when signs and symptoms are equivocal. Another of my pupils, Dr. Fleming, took many observations in a fever hospital on cases of scarlet fever, diphtheria, typhoid fever, etc., to see if in myocardial affections changes were betrayed by variations in the *a-c.* interval. His results were negative, and the method cannot be trusted; on the other hand, certain observers have noted changes in this interval in toxic lesions of the myocardium. The electrocardiogram may come to our aid, but as yet Einthoven, Nicolai, and others warn us that essential values cannot yet, at any rate, be calculated from it; but waning of the "final oscillation" suggests cardiac insufficiency, but so far no considerable final wane has been recorded from a certainly degenerate heart. Exercises and digitalis amplify it.

Now, when such estimates have been attempted, what means have

[1] Die Messung d. Herzkraft München, 1905.
[2] Amer. Jour. Med. Sci., Oct., 1907.

we for promoting the tone of the heart; that is, of shortening its diameters, so that it shall act at a better advantage, and thus be in a better position to drive its own circulation and to establish a supernutrition when required for the promotion of the enlargement or regeneration of its tissues. It is evident that in using such means we must act on the heart as a whole—there is no attaching them to particular parcels of it. Happily this matters little; the muscular structures of the organ are so continuous and interdependent that, as in the disadvantage of one part all suffer, so we may act upon all for the succor of a part. By drugs, such as digitalis, strophanthus, strychnin, the caffein group; by certain other drugs of which we possess as yet no accurate knowledge, such as convallaria, cactus, or adonis; by alcohol perhaps we can call upon the cardiac reserves; by baths and exercises, and perhaps by certain physical agencies, such as massage, friction, or electricity, we may do more. We may increase the volume of the contractile tissue, the total cardiac energy. These are the direct remedies. There are other means —the indirect—by which we do not reinforce the heart immediately but compass its recreation by easing it of some of its work. Its work may be eased by lowering peripheral resistance, as by cleansing the blood and perhaps by reducing its volume; by diuretic, laxative, and diaphoretic means; or, again, by vasodilators, which, by expanding the peripheral vessels, reduce the friction, which is more than 90 per cent. of the heart's work. Iodid of potassium also is said to have some obscure property of reducing arterial pressure. Now, as in considering the various valvular diseases we shall have to refer continually to one or other of these agents or combinations of them, it will conduce to clearness and brevity to set forth at the beginning what we know of their effects, so that in the succeeding discussion we shall not have to describe their virtues again and again.

Digitalis.—In health the chambers of the heart under large variations of stresses undergo corresponding and not inconsiderable variations of diameter; but when within a chamber of the heart the pressure per unit of surface is extraordinary or persistently excessive, the wall may be stretched so far that the increase of the diameter of the cavity exceeds the contraction values, and the cavity is not emptied; thus surmountable stresses come to abut upon strain, and the part may be stretched perilously near its physical limits of elasticity. Under these conditions, unless the muscular value has been much reduced by poisoning, as by diphtheria or influenza, or by intrinsic decay, we happily have a sovran remedy in digitalis. There has been a good deal of contradictory discussion as to the part and value of this remedy in cardiac disease, and a prevalent vagueness, tentativeness, and indecision in the use of it. This indecision is due, in part, to the want of apparent analogy between its effects upon the healthy and the diseased circulation; in part, to a discordance between clinical observations on man and experimental observations on animals. In clinical observations, again, the lack of precise estimates of blood-pressure has made for inaccuracy. Moreover, unfortunately, the preparations of this drug are inconstant,

and the reactions of individuals to the same sample of it are inconstant also. The advantage of digitalis is, therefore, so much the less that we are not only unable to foresee in a particular case what the drug may be capable of—this is a difficulty of profounder diagnosis inherent in all therapeutics—but to provide against the inconstancies of commercial samples and of individual reactions. The differences in the samples depend on the season, on the weather at the time of gathering, on the age of the sample, and the place where it is grown; the best digitalis is said to be that grown in the Harz Mountains. Practitioners would do well to follow the example of my old friend Dr. Braithwaite, who used to collect the drug himself and to administer the powdered leaves, or fresh infusions of them. The leaves should never be kept for a second year.

Withering's treatise on the foxglove (first edition, 1785) is a model of thoughtful and lucid exposition. He directs that the leaves, which he preferred to use, should be gathered "after the flowering stem has shot up and about the time the blossoms are coming forth. The leaf stalk and the midrib are then to be rejected, and the rest dried in the sun or before the fire, not too much." After drying they should be kept in the dark in glass or sealed tins. Of the dried leaves, rubbed down into a green powder, he used 2 to 4 gr. a day. He disapproved of a decoction, but he used an infusion, and alludes to other galenical preparations. When the drug caused vomiting or purging, he combined it with opium. He generally gave laxatives also, such as mercury and jalap.

Withering cautions the reader that no general deductions, decisive upon the failure or success of the medicine, can be drawn from the cases (of dropsy) presented to him, "which are of the most hopeless and deplorable . . . of the common run of practice." But many of these patients may be "snatched from destruction by the efficacy of the digitalis, and this in so remarkable a manner that, if the properties of the plant had not been discovered, by far the greatest part of these patients must have died. . . . Time," he adds, "will fix the real value upon this discovery, and determine whether I have imposed upon myself and others or contributed to the benefit of science and mankind."

Withering then describes how he drew away from the notion that the efficacy of the drug lay in its emetic and purgative properties, and found that its virtue, so far from depending upon these incidents, was more manifest indeed when by regulation of dose and vehicle they were averted. He mentions every case of dropsy which he treated with digitalis—renal, cirrhotic, etc.—pell-mell, without selection and without discrimination of diagnosis. In many cases, of course, he failed, but he was justified in regarding the series as a whole with complacency.

"Digitalis," Withering says, "seldom succeeds in men of great natural strength, of tense fiber, of warm skin, of florid complexion, or in those with a tight and cordy pulse" (hypertrophy with high arterial pressure), . . . "or if the belly be tense, hard, and circumscribed, or the

limbs in anasarca solid and resisting, . . . but if the pulse be feeble or intermitting, the countenance pale, the lips livid, the skin cool, the swollen belly soft and fluctuating, or the anasarcous limbs readily pitting under the pressure of the finger, we may expect the diuretic effects to follow in a kindly manner." Next to digitalis he thought nothing so good as squill, but when squill failed he turned to digitalis, which, moreover, "gives less disturbance to the system than squill. . . . Digitalis has a power over the motion of the heart to a degree yet unobserved in any other medicine, and this power may be converted to salutary ends."

Among the physicians who used foxglove after his direction Withering mentions "the late very ingenious and accomplished Mr. Charles Darwin."

To these instructions on harvesting the drug there is a practical rule to be added; namely, that as the leaves suffer no inconsiderable change by keeping, the prescription of the leaves, or of a fresh infusion of them, will prove stronger or different in autumn than in spring. The glucosids may change one into another; it is said the fresh leaf is less "cumulative." The amorphous form of digitoxin is said not to accumulate (Fränkel). Certainly "accumulation" is a very inconstant phenomenon. These fluctuations might be avoided if we could rely upon the active principles. Infusions concentrated for stock are very prone to decomposition, and, generally speaking, shop samples of all the galenical preparations fluctuate in potency from 10 to 75 per cent. or even more. The Leipzig digitalis pill is as follows:

℞. Pulveris digitalis foliorum ..... gr. xv to xxx;
Quininæ hydrochloridi ..... gr. xv to xxx;
Extracti valerianæ ..... q. s.—M.
Et fiant. pil. No. xxx.

The leaves are efficient and convenient, and are said to contain more of the active principles, but are a little more apt to irritate the mucous membrane, and are not so uniformly absorbed; next comes the infusion; this should be given in doses of 1 to 3 teaspoonfuls, intermitted, as we shall see presently. Pharmacists now say that it is clarified and rendered stable, at any rate for a week or ten days, by adding carbonate of soda (1 cgm. to 1 gm. of leaf), and allowing to stand for a couple of days; also that this mixture tastes better and agrees better. The tincture is most frequently used; it is often under standard, and the doses, to obtain the effect desired, have, therefore, to be increased, sometimes considerably. It should never be prescribed as an extract.

If the digitalis cause nausea, Fräntzel tells us this may be avoided by icing the infusion; or it may be given in a little effervescent saline. I have heard that to administer beforehand 15♏ of a solution of 6½ gr. of menthol in ½ oz. of tincture of orange-peel in a little water may relieve it. It is usually sufficient, however, to combine the drug with a little cordial and a light bitter, to give it with food or immediately after the meal, and to order then half an hour's rest. Digitalin may be admin-

istered subcutaneously or even intravenously at a crisis, but it is too irritating for regular use in this way; or, with some increase of dose, it may be given by the rectum; but these methods do not avert the stomach disorder and other unpleasant symptoms. Moreover, the dosage per rectum is very uncertain. If the drug irritates the coats of the stomach directly, especially, it is said, by its digitoxin, still some part of its unpleasant effects must come about indirectly, perhaps through the nervous system. For continuous use the powdered leaf is perhaps then the best, on the whole, remembering the precaution to diminish the dose a little after the fresh leaves come into use.

Concerning the alleged "cumulative action" of digitalis I have little to add; digitalis is as strong as it is a fickle confederate, and no searching drug, especially if of uncertain standard, can be administered after a negligent or routine fashion. If we give too much of any strong drug, or give it too fast, we may be punished suddenly: salivation by mercury often appears with a sudden violence. Moreover, every drug has its own degrees of absorption, adhesion, and excretion; and the relations between these factors are also variable. In digitalis the excretory rate is slower than the absorptive rate, and its molecular adhesions seem to be strong. That any such sum as 30 grains can be fixed as the saturation limit for an adult is mere fantasy. The stomach symptoms of digitalis vary with personal susceptibility, the limits of which are very wide, and they may be persistent or occasional. They are not perilous, unless in an indirect manner; but as they often persist obstinately and distressingly long after suspension of the drug, we must not lightly incur the risk of them. Sudden poisoning, with retarded pulse, faintness, and arrhythmia, is, I suspect, often attributable to unforeseen variations in the glucosid content of the preparation dispensed. Moreover, the pharmacologists have made the uncomfortable suggestion that in old samples the glucosids may deteriorate into poisonous resins. Clinical observers are not yet satisfied that Cloetta's digalen—a 30 per cent. solution of digitoxin—if a convenient preparation, has any substantial advantage over the older preparations, nor that it is less "cumulative." Knoll's digipuratum (in tablets) is said to be less irritating to the stomach. Digitalis preparations are so irritating that it needs some boldness to inject them intravenously. Subcutaneous or intramuscular injections set up local lesions. After the heart has been brought back to the best which digitalis can do for it—and this, generally speaking, we can ascertain by the pulse rate and pressure—to continue the use of it may be to embarrass the organ. Of the "digitalis habit" alleged by some authors I have no knowledge.

Professor Wenkebach emphasizes the rule of most of us, that in regularly spaced intermittency the use of digitalis is improper, as this kind of intermittency may signify the very impairment of conductivity, and perhaps also of contractility, which digitalis itself seems apt to induce (Wenkebach, Mackenzie). Perhaps it converts them into the more static constituent of tone. I think that experience corroborates this warning; at any rate if the pulse ranges under 75. In the irregular

pulse—not the extrasystolic, but what Mackenzie calls the nodal rhythm—it is more surely efficient, and a little consideration of cardiac mechanics will tell us that the sum of output of equal beats exceeds that of unequal beats in the same time. Wenkebach says digitalis may set up the true pulsus alternans.

In feverish states, as we have said in the section on Acute Cardiac Diseases, digitalis loses much of its efficacy—in fever the vagus seems out of gear; the cardiac muscle, like other muscles, is nearly always enfeebled; but strophanthus is a more effectual drug in febrile states, as, for example, in pneumonia.

Digitalis is often used in combination, as in the well-known and very efficacious "Guy's pill," consisting of equal parts of digitalis, squill, and blue mass. Trousseau's wine, also, is an efficacious formula; it consists of digitalis, squill, juniper berries, and white wine, to which, after four days' maceration and filtration, acetate of potash is added; but it is not well to fall into the habit of using routine formulas.[1] Under other circumstances, as in pyrexia or cardiac or general debility, digitalis may well be associated in a pill with quinin (see p. 70), as practised by Niemeyer; that this constituent diminishes the stomach intolerance I cannot say. Speaking generally, it is better to combine digitalis with alkalies than with acids.

℞. Diuretin ..... gr. x to xv;
(or Theocin sodii acetatis ..... gr. iv);
Tincturæ digitalis ..... ♏ v;
Spiritus juniperi compositi ..... ℥ss;
Aquæ carui ..... ℥j.—M.

With caffein a good diuretic result may be obtained, and this combination is sometimes effectual in cases where there is some reason to distrust digitalis alone, as in slowish pulse, or in cases of uncertainty as to muscular values; in many cases of cardiac dropsy caffein alone should precede digitalis (see p. 82) for a day or two.

℞. Tincturæ digitalis ..... ♏ v to viiss;
Tincturæ belladonnæ ..... ♏ v;
Chloroformi ..... ♏ v;
Spiritus ammoniæ aromatici ..... ♏ xv;
Aquæ cinnamomi ..... ℥j.—M.

Other combinations, as with atropin iron, arsenic, iodid of potassium, etc., familiar to every student of medicine, will be noted in their proper places.

For my own part, during the last few years I have chiefly used the preparations known as Nativelle's, or Homolle's, granules of digitalin—preparations which, generally speaking, for toleration by the individual and for therapeutic efficiency, answer our purposes if not uniformly yet better on the whole than the galenical preparations. Schmiedeberg's

[1] The formula of Trousseau's wine has been varied at the Hotel Dieu, and so its effects have been various. Dieulafoy, in the 15th edition of his handbook, gives the proper formula as: Digitalis, 20 cgm.; juniper berries, 1 gm.; squills, 10 cgm.; white wine, 15 gm.; acetate of potash, 40 cgm.

digitalin also is spoken of as generally efficient and trustworthy. Unfortunately, the chemical constitution of these principles and their comparative virtues have not yet been defined precisely, but Homolle's and Nativelle's granules are very powerful and must be used tentatively and watchfully. None of these principles is in my opinion so well fitted for continuous use as the tincture, carefully dispensed. Like other preparations of digitalis the granules must be intermitted from time to time, but with due precautions they are as safe as other equally potent drugs. I begin with half a granule, and if I find no reason to the contrary, advance next day to a whole granule. It is not generally necessary to give two granules a day, and it is well—at first at any rate—to intermit the drug every third or fourth day. The granules of Nativelle and Homolle must not be administered subcutaneously, as they are apt, like most other preparations of digitalis, to set up local irritation. The digitalin wafers sold for this purpose may be without this defect, and the same advantage is claimed for digalen. A little glycerin should be added to the water of solution. Unless in case of immediate urgency I have not observed any advantage from the subcutaneous method—an inconvenient one, of course, for continuous use.

Again, as with any other strong drug, the use of digitalis must be well-timed and discriminating, and the initial doses small; its routine use, occasionally effective, may be perilous. When I ask a student, in the presence of a case of heart disease with accumulated venous stases—nay, even in the presence of a mere murmur of mitral regurgitation without any symptoms of illness—what he would prescribe, he is wont, in either instance, to write down at once *digitalis*—a blind routine. In the former case the walls of the stomach are probably congested, the liver is choked, there may be some pleural effusion, absorption is fitful, and the heart perhaps too much distended to respond; if, then, vomitings and irregular cardiac embarrassments follow, we must not be too ready to blame the drug itself. It is bad practice thus to call upon a laboring heart for more and more effort without first giving a hand to ease the burden under which it is striving. If we would relieve a laboring ass stumbling uphill, surely before we give it the spur we shall lighten its load. We must hold back digitalis until we have cleared the stomach, purged the liver and colon, perhaps tapped the pleura, and reduced intraventricular pressures and the pressure in the renal veins. When, as by full or fractional doses of mercury and gentle saline laxatives and diuretics, we have done this, when the load is better distributed and the ventricles have some room to play, we may venture cautiously to apply the spur to them; by digitalis we then may shorten the diameter of the cardiac chambers, and so multiply the effect of the sum of its contractions. In early phases of cardiac failure the effect even of exercises should be tested before turning to digitalis. But, on the contrary, if in cases of high venous pressure we are often hasty in throwing in digitalis prematurely, on the other hand, we may waste time and the patient's forbearance by awaiting too long the ameliorations of mere rest and general treatment. In

many early cases of simple dilatation, where the general conditions are favorable, the drug should be employed practically from the outset.

Again, cautious as we must be in introducing digitalis, and in persisting with it, it is an error to suppose that the drug is never to be used continuously. When compensation is stable it is not required, and may, indeed, be harmful; but, on the other hand, in a few cases of weak, but not very degenerate heart, especially in mitral regurgitation, a periodical or even persistent use of small doses of digitalis may be a staff of life. Against small doses the system seems to supply some antidotal protection. When the conditions of the individual are understood and are favorable, and the heart under it is fairly steady, but without it soon gives way, there is no definite limit to the duration of its administration, nor is it necessary to increase the dose. A little blue pill must be administered from time to time, and the patient should be warned to suspend the dose, and to notify his physician, if the urine should fall notably in the twenty-four hours, or if he have any sense of faintness, or if the digestion be disturbed. In a small minority of cases the peril is, indeed, not the continuance, but the sudden withdrawal of the digitalis. I sent a certain lady with a weak, dilated heart and a mitral murmur away from home with the warning that the digitalis, which she had taken regularly for many months, was not to be omitted, or, at any rate, not suddenly. Some three weeks later I was called to see her in a state of cardiac arrear which ended in her death. In the unwarranted fear of "cumulation" the medical man, who had taken charge of a patient of whom he had little personal knowledge, did stop the drug suddenly, and by so doing let her drift so far to leeward that she went on the rocks. This was a salient case of no uncommon want of judgment.

Dr. Mitchell Bruce has lately emphasized the old advice that if in ordinary doses digitalis is ineffectual, the dose, or doses, should be boldly increased. No doubt this audacity is occasionally, perhaps frequently, justified. But, unless the failure of the ordinary doses be due to a deterioration of the sample, we must not forget that hereby two grave risks are incurred, risks not so infrequent as to give a general justification to this practice—to the administration, let us say, either of a single large dose (30–45 ♏ of the tincture) or of a short succession of considerable doses (20–30 ♏ every six or four hours). The first risk, and no slight one, is that the stomach may be upset, and, if so, not for the day only; although the dose may not be repeated, vomiting may persist, in spite of remedies, for many days, even to the exhaustion of the sufferer. The second risk is implied in this quality of digitalis, that the vagus and muscular effects of it are not parallel, and that the larger the dose the sooner its action on the vagus anticipates its action on the cardiac muscle. In one of Dr. Bruce's cases this order was apparent in a fall of the pulse to 48; and this, moreover, in a case of aortic regurgitation. Now if in such a case the cardiac muscle be sound and lively, as, *e. g.*, in a sequel of rheumatic fever in a comparatively young person, we may decide to face the risk; but in case of degeneration, latent or probable, the heart may fail to emerge from the inhibition; or, on the other hand, the

vagus center may become exhausted, the ventricle may take up an eccentric rhythm, and the heart may hurry itself into dissolution.

It is generally understood that the extremer degrees of cardiac degeneration are incompatible with digitalis, especially when conductivity is much reduced and the rate retarded, but that degeneration in earlier and slighter degrees is no definite bar to its use; in many such cases it is both tolerable and helpful. Hirsch[1] indeed states that in toxic states, as in diphtheria, with a pulse 30 to 40 (!) he has found digitalis efficacious. In equivocal cases the patient should be put to bed for a few days, and the action of the dose carefully watched and regulated. Among the poor, and in persons whose nutrition from any cause is lowered, some renewal of nutrition and restoration of blood values should, if possible, precede the administration of digitalis. The effects of the drug are thus useful in prognosis; from a ready response to small doses we may infer a substantial survival of cardiac capacity. (See Tests, p. 66.) In a large proportion of non-toxic and non-atrophic cases, if the muscle be, indeed, below par in quality, it retains such a measure of capacity that the pressure will rise and the velocity of the blood may be increased. Speaking generally, however, the toleration and efficiency of the drug seem to be inversely as the quality of the cardiac fiber. Thus, in the valvular diseases of children and adolescents, in whom dangerous oppression by the vagus is scarcely to be apprehended, it is notably efficacious. If, then, we accept the aphorism that it is in falling arterial pressures that digitalis is called for, we must make some reservation as to the muscular integrity of the particular heart; this allowance made, the aphorism holds good, and is good not only for pressures falling below the normal, but for falling pressures in cases of hyperpiesis, when these are not signs of therapeutic relief but of a yielding heart. If in arterial hyperpiesis, with or without renal disease, the heart is yielding, digitalis may on occasion be an invaluable ally, much as the least pressures in such a case may exceed the normal. The whole equilibrium has to be sustained on a forced level.

It is, then, in the more mechanical dilatations of the heart, and when venous pressures are increasing, that digitalis is invaluable. Its effects are manifold: it acts directly on the cardiac muscle and ganglia, on the vagus, and on the vasomotor center. The blood-pressure rises in from ten to fifteen minutes, but diuresis does not appear for one or two days. So far as it acts on the vagus we have said that its influence may not be always or purely beneficial; if it do not arrest the heart—in aortic regurgitation perhaps not a baseless apprehension—it may slacken it, and contribute to an overcharge of blood. In case of such apprehensions, seeing that a large dose is more likely to tell upon the vagus, while a small dose anticipates vagus arrest by toning up the muscle, small doses must be tried cautiously. In a dose therapeutically precise for the case the vessels are emptied as desired; if the dose exceed this limit the vasoconstriction may be too much for the

[1] Penzoldt and Stintzing's Handbuch der spec. Therapie.

heart, the output may fall, and the urine fall. Still the coronaries, which obey oxydative activity, are probably not constricted; and, if the dose be not too heavy, a moderate acceleration of the rate may answer for a time. By close observation we shall perceive if this vagus influence, whatever its harm may be on occasion—and it must enter into the integrity of the compound function—is overborne for good by the beneficence of bracing up the muscular walls of the heart, by promoting tone. Tone, in a hollow viscus, is that property which enables the organ in spite of stress, even of excessive stress, either to retain its mean diameter or after greater distension to recover it. It is manifest that such an agent will reduce the residual blood in all chambers. The diastolic dilatation is, indeed, more, but as the systole is stronger, more blood is received and expelled on the arterial side, and velocity is increased, and the heart nourishes itself more efficiently. In experiments on animals digitalis may thus raise systolic pressure by 200 per cent. When I am apprehensive of the ill effects of digitalis by way of the vagus I combine with it a little atropin (p. 162 Angina Pectoris). Generally speaking, however, if in cardiac irregularity without much shifting of blood distribution digitalis changes the irregularity into a factitious rhythm and oppresses the heart, we must suspend it at once.

In dilatation of the right or left heart it is sometimes desirable to postpone digitalis, not only as we have said to some preliminary deobstruent treatment, but also until the working of rest, baths, massage, or other gymnastic means is appraised. Then, assuming the pulse rate to be not under 70 or 75, the drug may be administered, at first in a single moderate dose, once in twenty-four hours. If half a digitalin granule, or a teaspoonful of a fresh infusion, given in the evening of one day, have no ill effect, a like dose may be given on the following evening; then, if the omens be favorable, a second dose may be given within the day. The augury, I repeat, is taken on the chamberpot—*augurium valetudinis ex urina.* If the total quantity of urine passed in the twenty-four hours be maintained, we are not discouraged from this repetition of the drug; if it be increased we are encouraged; and we are encouraged to pursue its use, with intermissions, so long as the general condition seems to improve: always keeping an eye to the urine, and taking a foreboding from any diurnal diminution of it. At the same time we shall not forget that, in dropsy, as the effusion is dissipated the quantity of urine will sink. The difficulty or doubt in the administration of digitalis is usually in the first few doses; a routine administration of the drug every six or eight hours, without these precautions, might lead, and often, in cases otherwise promising, does lead to a grave setting back of the patient's condition, as indicated by nausea, by an artificial cardiac rhythm, etc. For this reason, even in mitral regurgitation, wherein its use is safest, the first few doses of the herb should be given at intervals long enough to enable us in case of disappointment quickly to retrace our steps. It is rarely desirable to give digitalis when the heart's action is below 70; but in the dilated heart with much residual blood we generally find the pulse accelerated.

During the last few years some detractions from the usefulness of digitalis, even in mechanical dilatation, and in its proper order in the treatment of dilatation, have found their way into discussion on account of its property of constricting peripheral vascular areas, and thus, if these are extensive, of increasing the mean arterial pressure. For this reason we are urged to combine vasodilators with the digitalis, or to resign it altogether, or temporarily, in favor of other cardiac tonics which have not this property, or have it in much less degree. These suggestions, based as they are upon arguments of some plausibility, deserve attention. They stand, so far as I know, on a speculative basis only, while my own experience, at any rate, indicates that vasodilators —such as the nitrites—so far from expediting the good effects of digitalis in appropriate cases, have a contrary and even noxious effect.

Now this problem lies deep in the processes of cardiac function. Whatsoever the coincident effects of digitalis on peripheral resistance, effects which might be counteracted more or less by depressor agency, the sum of its effects on dilated heart of many kinds are so strikingly beneficial that it is hard to suppose its action to be seriously handicapped by interfering qualities; if we estimate its effects clinically, and in the sum, we cannot but regard them as conspiring for good. Nay, is it not probable that some of the virtue of digitalis may lie in this very increase of arteriolar tone? The initial effect of artificial exercises is, likewise, to raise arterial pressure by way of peripheral constrictions; yet the means, so far from being injurious in heart disease, often aids, somehow or other, in the attainment of the ends we desire. Strychnin, again, the good effect of which is well seen in failing heart, reduces the caliber of the arterioles through the vasoconstrictor center. By our too frequent disappointments with digitalis, or with exercises, we discover, it is true, that the working together of these various factors for good is not always to be reckoned upon, and that we must use the compound properties opportunely, when the organ is in a certain kind of disease, and in a certain phase of it. Then, remembering the obscurity of pathologic problems but guided by experience, and speaking broadly, as we resort to digitalis when we see arterial pressures falling, may we not presume upon a consistency between rising arterial pressures and cardiac recovery? We cannot have a worse state of things than a low diastolic pressure with an excessive intraventricular load; and in all favorable cases the higher upstroke of the lever indicates that the output and velocity are increasing. If, as the periphery is pulled in, velocity falls, a little renewed cardiac energy should give a fresh impulsion. Unless in valvulitis, indeed, it is hard to think of a disease primarily cardiac where we should desire a fall of arterial pressure. If the velocity of the sluggish blood-stream is to be increased we know that, if there be a rising pressure head, a narrowing of the channels will make for acceleration; and we know that, as in the cases before us, heart failure means by one way or another slipping of the blood from the arterial into the venous tree, with venous plethora; and if so, arterial constrictions regulating the differential

pressures in arterioles, capillaries, and venules will tend to counteract accumulation in the great veins. If it be true that digitalin constricts only, or chiefly, the splanchnic vessels, and digitoxin the whole of the arterial system (Gottlieb and Magnus), we may find ourselves able thus to vary our attack with advantage. The overlapping and various preponderance of these glucosids, by observation and experiment with each singly, is of immediate practical importance. But digitalis does not constrict the arteries only, it constricts the ventricles also; and for the heart to work under increased pressure with a more compact ventricle may be far better than to work against low arterial pressures with a dilated ventricle. There is no more interesting clinical illustration of these factors than to observe, in a case of the faltering heart of mitral regurgitation, how the first doses of digitalis raise arterial pressure; and how as velocity increases the pressure then falls, to rise again as the heart gains more and more advantage. Again, a rise of aortic pressure, by filling the coronary arteries, nourishes the heart; and, moreover, by driving more blood into the bulb arouses the nervous side of the cardiomotor conditions; thus, so long as the pulse is not slowed too much, regularity of output is promoted. The volume of coronary circulation is directly as the rate of intracardiac oxidation. Furthermore, to lengthen the pause gives rest to the heart, as well as more time for the auricles to deliver a fuller tale of blood. It may be that sometimes when digitalis disagrees it is because of an undue predominance of one or more of these factors, one evidence of it being a relatively excessive retardation of pulse—say, for such cases, below 65. Or if the blood be gathered in excess on the venous side, the left ventricle may be underloaded, and ready for the stimulus of a more normal loading; for in cardiac dilatation it is often the right rather than the left ventricle which is overloaded. It has been said that digitalis has more power over the right ventricle than over the left; but I suspect this is less a matter of intrinsic susceptibility than of this venous preponderance; and, if this be so, vasoconstriction should be welcome, as retaining on the arterial side blood which otherwise would gather more and more about the right side of the heart. Besides, although the pulmonary vessels are but little, if at all, under vasomotor governance, yet, by its direct effect on their muscular coat, digitalis may promote some constriction of them, and so make for velocity in this area. Finally, if we find, and in many cases of dilatation we cannot tell till we try, that the muscle is in fair condition, we may invigorate a suction action of the ventricles; while, on Ludwig's hypothesis, we shall also tighten up the mitral orifice in systole. If the muscle be in too bad a condition for these several factors to come reciprocally into play, no nitrites will help us; but caffein, rather, or strychnin. This much, at any rate, we shall admit, that if a rise in arterial blood-pressure be not a cause of better circulation it is an important coefficient and sign of it; and that the wise practitioner will consider the circulatory system as a whole, and the pressures within it integrally rather than differentially, not weighing too curiously the

bearings on this section of it or on that. That digitalis is useful only in "nodal rhythm," as such, and irrespective of myocardial decay, I am not prepared to admit. If, however, the myocardium be intimately unsound, we may find the drug persistently ill tolerated and ineffectual after all the caution of our trials. I surmise from clinical inference that the drug is inappropriate and even dangerous in coronary atheroma.

It may be well, notwithstanding, to repeat here, categorically, that in certain kinds of disease the heart must be immediately protected, and low pressures secured on both sides of it; namely, during inflammatory, intoxicative, or gravely degenerative processes of the muscle, valves, or investments. In myocarditis, in valvulitis, in pericarditis, in myolytic decay, etc., our eyes must be narrowed to the immediate sparing of the heart itself; so in practice we find in such cases that digitalis is rarely beneficial, and usually mischievous. In acute rheumatic endocarditis we have seen that, even at some sacrifice of the balance of the circulation, at some sacrifice even of the due nutrition and efficiency of the body and its members, we must be content for a time to see the left side of the heart reduced to the least work compatible with bare existence.

It will be inferred from what has gone before that digitalis is not often required in functional cardiac disturbance. It is not often suitable for "neurotic" cases. In a small and occasional way, it may be helpful; it is not infrequently serviceable in toning up the rather fagged hearts of some elderly people, especially of women; if these cases can be called "functional." In the persistently irregular hearts of obscure causation, many of which we call "gouty," and in which the rate is usually accelerated, digitalis often oppresses the patient by setting up a conflicting rhythm of its own. For these cases strophanthus is more effectual. James Mackenzie directs us to the measurement of the *a–c* interval on the venous curve as a guide; by reduction of conductivity under digitalis this interval may be lengthened beyond a fifth of a second, and ventricular contractions may drop out, even in young persons. In old persons this reaction as a peril was, in substance, pointed out to me on clinical evidence forty years ago by a shrewd family physician. It is, of course, in young persons with rheumatic lesions that we shall find most success with it, but even in them retarded or grouped rhythms warn us to put off the drug to a more suitable phase of the malady.

If, then, the distribution of the blood in the body be fairly equable, digitalis will rarely be wanted. Thus, the conditions which dictate its administration, if we allow for the susceptibilities of individuals, are not obscure; that is, if the heart, even in an elderly patient, is yielding rather from atony or high intraventricular pressure than from intrinsic degeneration; if its transverse area be enlarged; if the urine is diminishing and the arterial pressure falling; if there is a little dyspnea, a little edema, and probably some residual blood in the heart, but no great venous stagnation; and if the nutrition of the patient be not unfavorable, digitalis is likely to serve us well. It is our continual duty to

avail ourselves of those methods of observation and physical diagnosis that we may ascertain from day to day where the case stands in respect of these definitions. But we must not look to murmurs for guidance, not even to an aortic regurgitant murmur; and in chronic Bright's disease digitalis may be needed before a mitral murmur becomes audible.

Strophanthus.—If we have difficulties with digitalis because of the instability and the uncertainty of its principles, with strophanthus our difficulties at present are still greater. I say "at present," as the chief difficulty, that of purity and genuineness, ought to be but temporary. In the Cambridge laboratories Dixon and Haynes are comparing the standardization of all of our "heart tonics." A pharmacologic friend of mine bought from many druggists specimens of tincture of strophanthus: in one there was no active principle whatever; the rest varied from 30 to 40 per cent. of standard activity up to the one, one only, which proved to be of full value (*i. e.*, about 80 per cent.). Probably not one in twenty of the prescriptions of strophanthus as dispensed is of normal standard; those dispensed at cheap rates are probably almost or quite inert. The druggists are not generally to be blamed; they presume that the tincture supplied to them is good; perhaps, indeed, the manufacturers themselves are under a like impression; they cannot personally ascertain the genuineness of the bean, or of its preparations; for it is only by physiologic tests that the intimate quality of these can be determined. It is to be hoped, however, that by careful selection of the beans, and conformity to standard, some fair uniformity may soon be attained.

This being so, it follows that much of the experience of physicians of strophanthus is untrustworthy, if not misleading. Probably it is for this reason that the drug has fallen into some discredit; yet if every now and then it may have disappointed us, we can all relate occasional cases in which the drug acted with surprising efficiency. Professor Greenfield, of Edinburgh, where the standard of Sir Thomas Fraser is no doubt prevalent, assures me of the remarkable efficiency of strophanthus. "In no cases," he says, "is its virtue more distinctly manifested or more welcome than in pneumonia with distention of the right side of the heart;" a state with which, whether in pneumonia or otherwise, we so often have to deal. Strophanthus is said to have less constrictive effect on the peripheral vessels than digitalis, but as after a brief moment of excitement the pulse is slowed, this is doubtful. As it does not stimulate the vagus, it is appropriate in cases such as "senile heart," in which these factors, vagus interference especially, are to be avoided; it seems to have a more simply peculiar effect as a goad for the cardiac muscle. In the worn and slipping hearts of old people, cases in which digitalis often fails, I have found strophanthus often efficacious. Moreover, it is remarkable that we do not hear of the sudden deaths during the use of strophanthus which, rightly or wrongly, are not infrequently attributed to digitalis. Dr. Sainsbury finds that in some cases it is better to add strophanthus than to increase the dose

of digitalis. For the present then we must be content to note that in incidental cases strophanthus, used empirically, answers our purpose when digitalis for some reason has failed; and it makes a very good follower of digitalis. Generally speaking, it is tolerated better by the stomach than digitalis or squill; though it too is occasionally attended with gastric irritation. Subcutaneously administered, the tincture of strophanthus, even if injected into the muscles, is painful; although the equivalent dose is one-tenth of the dose by the mouth. Pharmacologists are actively engaged in isolating or comparing the active principles of drugs of this class, and in avoiding the impurities and lapses of the galenic preparations to which much of their intractability may be due.

A preparation called G. strophanthin, which is administered in 5- to 10-minim doses of a 1 per cent. solution, seems to be more trustworthy than the ordinary tinctures. Haynes, in our laboratories, has found Böhringer's strophanthin very uniform; but it is alleged (as at the Kongr. f. inn. Med., 1905) that the tincture of strophanthus has some useful sedative quality, an advantage in which strophanthin is lacking. Strophanthin is separated as a crystalline from S. kombé, and seems identical with ouabain from S. glaber. From S. hispidus it is separated in an amorphous form, which is $2\frac{1}{2}$ times less toxic; so that the precise provenance of the alkaloid is of great importance to the practitioner. Much also depends on the mode of administration. For all ordinary purposes the best form is perhaps the titrated extract of strophanthus, given by the mouth. Strophanthin, except for some smarting, is very efficacious when injected into the muscle, being well tolerated and apparently not cumulative. Intravenous injection depends upon skill and practitious caution of method, and should be reserved for moments of extreme peril; but some really marvelous recoveries from cardiac failure, intrinsic or incidental, as in pneumonia, for instance, by the intravenous use of strophanthin, have been recorded on good authority—*e. g.*, by Fränkel and others in Germany, and Baccelli in Rome; but the method must not be lightly adopted until we have far more testimony to safety as well as efficiency. For intravenous use strophanthin is sold in sterilized tubes of 1 mg. For the method of injection Hirsch gives the following instructions: To make the arm vein stand out a rubber band is best, the tightness being regulated so that the cubital vein fills without diminution of the radial pulse, and the fastening so handy that its removal, even by an unskilled person, may not disturb the arm in the least. If the vein is pierced a show of blood will appear in the syringe, whereupon the band should be promptly removed and the solution slowly and gently passed into the collapsed vein. In a recent able thesis for M. D. degree (1910) on "Cryoscopy of the Blood," one of our graduates, Dr. Lydiard Wilson, drew an ounce of blood from the arm many times over without ill consequences. He said that entry into the vein even while collapsing can always be perceived by the play of the needle. He used careful sterilization of the skin, and after boiling kept his needle in absolute alcohol. But, of course, to inject a medicated solution may not be quite so innocent a procedure. If in extreme

cardiac distress with cyanosis and failing radial pulse, and if, while the peril is imminent, the heart is presumably more under defeat than gravely degenerated, the risk may be sometimes, ought to be, taken. Still the results in a few cases have been disastrous (Barié), cases perhaps desperate anyway; in a considerable number, however, within a minute or two the pulse has improved, pressures have risen, the cyanosis has disappeared, and diuresis set in. If the patient has taken digitalis within twenty-four hours the strophanthin should be withheld, or a half dose only given. It may be better to avoid the use of it in Bright's disease. In "neurotic heart" strophanthus is of no service.

Squill.—This ancient drug, well known, as a remedy for dropsy, to Dioscorides, Pliny, Galen, and Celsus, stands high among the arterial pressor agents, but nowadays rather in the pharmacologic laboratory, where it is usually administered by a vein, than in clinical experience. Its active principle, or principles, are not yet well made out; nor do we know exactly the effect of digestion upon its glucosids. It would seem from clinical experience that, although these principles pass the stomach with some of their efficiency unimpaired, yet some impairment there is; more than in the case of digitalis, for instance, for it cannot be said by the physician, who gives it by the mouth, that squill has the efficacy of digitalis; while to the stomach squill is, perhaps, even more irritating. For my own part, the combination of digitalis with mercury has seemed to be as effective as this combination with the addition of squill, but we need more definite comparisons on the subject made under the control of the sphygmometer. Nevertheless, this old cardiac remedy should not be allowed to fall into neglect. In some cases the prescription of 15 minims of tincture of squill every four hours may succeed when others of these capricious cardiac remedies have failed. Dixon and Haynes regard squill as little if at all inferior to digitalis and strophanthus, and appeal to the physician to try it more systematically, and by itself. It is contained in "Trousseau's wine" (p. 72); and it may be given as follows:

℞. Potassii acetatis.....gr. xv ;
Aceti scillæ.....ɱxxv;
Syrupi pruni virginianæ.....ɱxl;
Aquæ pimentæ.....℥j.—M.
S. Three or four times daily.

Caffein (and **theobromin**) and its congeners have received some attention in the section on Acute Cardiac Disease; paragraphs which need not be repeated. Prof. Dixon[1] sums up our knowledge of this group in results which seem to accord with clinical experience. It seems that caffein promotes output by muscular acceleration beginning in the excitomotor area at the junction of the auricle and the great veins, and extending thence from the auricles into the ventricles. There is some stimulation of the vasomotor center, as Pässler stated, but not of the peripheral muscular vessels; and we are free in the use of caffein from vagus interferences. It seems suitable, therefore, for cases of retarded

[1] Manual of Pharmacology, 1906.

conductivity. On the whole, pressure tends to rise, especially at first; later the periphery begins to dilate a little, but not so much as to lower pressure, for an augmented output persists. It must be remembered that this reinforcement is at some sacrifice of rest in the pause; but there is less objection to this in those cases of retarded pulse in which caffein is a useful and often a valuable substitute for digitalis. Personally, I have found caffein a very valuable remedy in heart disease. The pure caffein is the most stable, but, being insoluble, its absorption is uncertain. It is now usually given as a salicylic salt; or it may be given as follows:

℞. Caffeinæ.....gr. j to v;
Sodii benzoatis.....gr. iv to x;
Tincturæ aurantii.....ɱxx;
Aquæ chloroformi.....ad. ℥j.—M.

The diuretic effects of the caffein group are not the least of their virtues. The problems of diuresis are still very obscure; but it would seem that if caffein has some direct influence upon the secretion of the kidney ("epithelial diuresis"), that on its vascular conditions is at least as considerable. Prof. Dixon says that at first, by augmented output and vasoconstriction by central stimulation, the pressure rises; the renal vessels then gradually constrict, and the kidney volume diminishes, for the moment, with a parallel diminution of urinary flow; but in ten to thirty minutes the renal vessels begin to expand largely, with a corresponding enlargement of the kidney, and continue thus for one to three hours. This accords with what we find clinically in man, when conditions are not unfavorable to this medication. At this stage it, or theobromin, may be combined with digitalis, and, in some cases of failing compensation with edema, with striking advantage.

Remarkable powers of counteracting collapse, and of sustaining the heart in acute toxemias, when digitalis is less appropriate, have recently been claimed for caffein by more than one school of physicians. By the action of the vasomotor center, already stated, caffein is said to be invaluable when the blood is gravitating into the bowels. In urgent cases it may be given by subcutaneous or intramuscular injection (gr. 1½–3 in aqueous solution with benzoate of soda), or, indeed, intravenously; and at a crisis a few very large doses may be administered—as, for example, in pneumonic collapse—doses of 5 gr. singly, or amounts of 30 gr. in twenty-four hours. If experience substantiates these statements we shall have a useful alternative to strychnin. Caffein acts more on the heart, theobromin on the kidneys, with, so it is said, increase of the urinary solids. Acetate of potash, a diuretic too much neglected presumably for its nasty taste, makes with these purin series a very effective combination.

Theobromin is said to have less central vasomotor influence, and Dr. Tyson, of Philadelphia, who gives it by 7½-gr. doses every three hours for six days, regards it as one of our best diuretics. It may be given in hot milk, or placed on the tongue and washed down by a drink. Theophyllin (theocin) and agurin have also their advocates, and, espe-

cially by their relative solubilities, may deserve attention. The salicylic preparation of theobromin, called diuretin, useful as it is, may possess no peculiar advantages, unless it be in acute rheumatism; but these agents need a long series of clinical comparisons. Diuretin is said to promote the excretion of salt, which in edema would be helpful. It is no negligible quality of caffein and theobromin that they stimulate the psychic centers, and thus raise and encourage the spirits. In this indirect way not infrequently they may even promote rather than banish sleep. Theobromin is less "wakeful" than caffein.

Theocin, a synthetic xanthin preparation, prescribed as the sodium acetate with bicarbonate of soda, and administered on the full stomach, is sometimes extraordinarily efficacious in dropsy when other means have failed. It may be combined with digitalis, but it is not so harmless a drug as theobromin, and it is better to give it alone and only for two or three days; 4- to 10-gr. doses may be given thrice daily, and alternated with digitalis or other means. It is apt to disagree with the stomach, and on the first day should be administered once only. Euphyllin, a modification of this class of agents, is said to be as efficacious as theocin, while free from its occasional toxic effects. It is soluble and easily given by the mouth. Either of these drugs, if used, may be given in suppository.

Strychnin, in its theoretic and practical appreciations, has been discussed (p. 53, Acute Cardiac Disease); that it is a prompt remedy for instant needs every obstetrician knows who has seen the uterus, under a subcutaneous injection of it, contract in three minutes; whereas the effects of digitalis scarcely appear before the third day. It acts thus directly and separately upon the myocardium. Experiments on animals suggest that a combination of strychnin with inhalations of oxygen might prove efficacious. Bayliss says that the influence of strychnin upon the vasomotor apparatus is too complex for calculation. It is not appropriate for "functional" cases, at any rate not in the "neurotic" or gouty varieties.

Ergot.—In the earlier days of my practice ergot was a favorite drug in cardiac disease, especially in failing heart; but whether from presumption or experience I hardly know. Its lapse from common use is probably due to the untrustworthy preparations of it, and to the inability of the chemists to provide a steadfast active principle. Although ergot has been studied by many chemists, these difficulties have not been overcome on a commercial scale; yet, so far as we can judge from such laboratory results as we have, there ought to be an important field for ergot in heart affections, especially in cases where the left ventricle is insufficiently loaded because of gravitation of the blood into the bowels. Ergot should by reinforcement of the dilated heart and bracing of the peripheral vessels be valuable, in subcutaneous doses, in cases of rapidly falling pressures; from the phenomena of ergotism we know how protracted its constrictive effects may be. Its constrictive action is not so directly on the vessels as that of adrenalin, but is effected rather through the nervous centers. Prof. Dixon finds that

ergot contains a principle akin to and perhaps identical with the pressor principle of putrid protein. Ergot increases the output and the energy of the heart, but does not affect the vagus nor retard the pulse rate. Moreover, on laboratory animals at any rate, its effects persist for some hours. A combination of ergot and spartein has been recommended recently as a diuretic in cardiac failure with pulmonary edema, hepatic congestion, etc.

Adrenalin acts in much the same way as ergot, but more powerfully than any vegetable drug. It acts more directly on the peripheral nerve-endings; and in distentions of the pulmonary vessels, by virtue of its action on the muscular coat of its ramifications, no drug, unless it be pituitary extract, can compete with it. Its virtues are destroyed more or less in the stomach, so that it must be administered by the mouth in large and repeated doses, or far more effectively intravenously (0.5–1.0 c.c. diluted, if desired, with 9 c.c. of saline solution), no easy operation even on occasion; and for systematic administration this method is, of course, impracticable. It does not seem, then, that either ergot or adrenalin are, as yet at any rate, to supersede digitalis and strophanthus, save at critical moments, as in collapse, when adrenalin may prove invaluable. As, however, the similar virtues of pituitary extract (gr. 2–5) have more persistent effect, this agent seems likely to supersede adrenalin. Dr. John D. Rolleston finds them both more useful than any other means in the cardiac failure of the acute stage of diphtheria.

However, in respect of both these drugs it must be remembered that their action is but little upon the myocardium in comparison with that upon plain muscle (Dale). They are indicated, therefore, in case of heart failure, not in case of intrinsic inadequacy, but of defective load on the left ventricle. The load is to be restored by peripheral and especially by splanchnic constriction. If the left ventricle be already overloaded and distended, adrenalin may do harm by still further reduction of velocity in the pulmonary as well as in the arterial system.[1]

Alcohol.—The influence of alcohol in heart disease, and in secondary embarrassment of the right heart, as in pneumonia, is a subject as difficult as it is important. In the chapter on Acute Cardiac Disease some consideration is given to it which need not be repeated (p. 51). I confess that I am not clear about the principles of its action, and feel no little anxiety in advising any liberal use of it in particular cases. That it does act as a powerful cordial in heart failure is undeniable by anyone who has averted a faint by a glass of wine, or watched its effect upon certain feeble, irregular, or rapid pulses. To apply a bottle of ammonia to the nostrils has a similar if more transient effect, and the reason may be the same in both cases; namely, that the action is wholly or in part a reflex, in the instance of alcohol a stomach reflex. A glass of hot water has, indeed, some of this potency as a cardiac restorative, but it is certainly in less and less abiding degree. So far as direct effect on the cardiac muscle goes, that of alcohol certainly appears to be a

[1] See Edmunds, Amer. Jour. Physiol., March 1, 1907.

potent temporary restorative. But if we have reason to fear a dilatation in the splanchnic area, alcohol may be a treacherous ally; nevertheless, it is in collapse, or at any rate in the initial stage of it, that we turn to alcohol most frequently, whether wisely or unwisely it is not easy to decide. And if we admit that under certain ill-understood conditions its restorative effects are unquestionable, on the other hand, they seem to involve a graver reaction than with other stimulants. In so far as the effect of alcohol for good is by way of a nervous reflex action, to persist in the application of this stimulant to the coat of the stomach must blunt the susceptibility of this surface; thus alcohol should be given—as, indeed, it usually is given—in occasional doses; it seems certain, moreover, that within limits it is useful also as a concentrated and readily absorbed food, and that it is assimilable more or less by the cardiac muscle. As by the features of the individual case we cannot yet formulate any broad rule about alcohol, the physician must himself then decide from day to day the kinds and doses of alcoholic stimulant to be prescribed, vigilantly watching their results. In severe cases of cardiac oppression or intoxication physicians whose clinical experience deserves the greatest respect—Broadbent, for example—have relied on alcohol boldly during critical phases, pushing it even to quantities of 10 ounces of brandy per diem.

Our knowledge of the physiologic effects of alcohol, as investigated by several observers—among whom I may mention Cabot, Wood, and Hoyt in America, Johns in Germany, Waller in England, and in our own laboratories Rivers and Dixon—seems to be verified thus far: That in quantities of more than 2 per cent. in the blood the whole state is impaired; that in moderate doses after some minutes the output begins to increase, and so may continue for one-half to one hour; that the systolic level rises, the diastolic remaining, as a rule, constant, though it may fall; that the periphery is widely opened, as shown by the plethismograph on the arm; that the velocity is much increased, possibly doubled; that the beat rate is usually increased, but this depends on the ratio between the mere heart work and the peripheral expansion; that the blood-pressure is unaffected; that in dogs made febrile by infection the results are the same as in the normal dog; and finally—which is very important—that for some of these reasons, and also because section of the cervical cord with splanchnic vascular palsy greatly modifies the results, the peripheral expansion seems to be chiefly or wholly in the systemic areas. It seems probable then that in moderate doses alcohol usually accelerates both beat rate and velocity, and amplifies the pulse; the heart, therefore, does more work. Rivers, however, who (in man) administered alcohol by stealth and in insipid mixtures, thinks these results are in some considerable measure psychical or affective. Waller and Dixon are disposed to make the same demur.

In the septic conditions alluded to under Acute Cardiac Disease, it was said that alcohol may be used liberally, especially if the tendency to chills or rigors is evident, when it seems to act in release of the vas-

cular constriction; there are other cases also where expansion of the cutaneous area seems desirable. Perhaps the popular prescription for a "chill" of hot spirits or wine and water at bedtime may be justifiable. Alcohol, again, is helpful in the cardiac distresses of old people, as in senile pneumonia, perhaps by arousing the nervous or psychic energies; although here, again, there is some well-grounded fear of administering alcohol in doses so large or so frequent as to reduce the sensibility of the brain from the psychic areas downward to the vital centers of the bulb. Furthermore, a little alcohol is often a temporarily advantageous addition to a digitalis mixture, or a vehicle for it. In grave toxic conditions, when the heart is suffering as we see in the "typhoid state," there can be little doubt that alcohol is often a potent remedy, and, as is well known, its efficacy may be tested by the simple means of watching the pulse during the first ten minutes after administration: if the pulse falls in rate and rises in pressure the drug is acting beneficially, as well on the heart as on the nervous system; probably, indeed, the heart is aided indirectly through the nervous system. If, on the contrary, which is in my experience no infrequent alternative, the pulse is not influenced, or is still further accelerated, we know that the drug must be suspended or much moderated. Cabot thinks alcohol of little service in typhoid fever. But an able physician, himself a teetotaller, told me that in the South African War his experience compelled him to push alcohol in some desperate cases of typhoid fever to large amounts, whereby not a few were, in his opinion, saved. Probably these campaigning patients were psychically more depressed. Such therapeutic observations on the circulation in fevers are not without their application to general cardiac therapeutics, especially in toxic cases—whether febrile or not. The heroic doses of alcohol formerly given in septicemias have been found at best ineffectual

If reflex stimulation be an important path of its action, the injection of alcohol under the skin, except, of course, as an insignificant dole of food, must not only be locally irritating but also ineffectual, and such, I must say, is my experience.

It is no matter of indifference, then, whether we grant a free use of alcohol or keep a sharp eye upon its consumption. While not convinced of its more than occasional and temporary value as a medicine in cardiac cases, I am convinced by daily experience of the harm done by its free and continuous use; especially when the liver and stomach are engorged, or are apt to become so. In the majority of patients suffering from large tender livers, sickly stomachs, and, perhaps, some hyperglycemia, these conditions are not mitigated by the habitual use of alcohol. That immediate relief, or a sense of relief, may be given by brandy or wine is unquestionable; it raises the spirits of the downhearted, it dulls the sense of strife, weariness and defeat; but—it is an old story—the doses must be larger and larger, or more and more frequent; the brandy slips in as part of the "nursing"; teaspoonfuls grow imperceptibly into tablespoonfuls, and what should be the

solace of a tedious meal degenerates into dramdrinking. Indeed, when there is much gastric catarrh and the liver is large and tender, it is best for a time to withhold alcohol altogether. By all means let the sufferer have anything that can assuage his miseries, in reason; but let him not, by blunting his consciousness of them, undermine the powers of resistance, and hamper the activities of the viscera on which the amelioration of these miseries directly depends. Let the brandy bottle be kept with the digitalis and the strychnin and other medicines; with the meal a moderate glass of good claret, hock, or light sherry should suffice for cheerfulness. Beer is, perhaps, more admissible in heart disease. Champagne, unless it be of the finest brands, of an age and quality beyond the ordinary purse, is unwholesome; it is acid and fermenting. Aërated waters, again, often used in excess as fluid, are apt to distend the catarrhal and atonic stomach, and thus to embarrass the heart still further.

Of other cordials in heart disease, passing over those in common use, I may refer to *Castoreum*, as the tincture suspended with a little mucilage in such a vehicle as cinnamon-water. The pure drug is very expensive, but for wealthy patients I have often used it, and found it most useful in cases of frail arrhythmic heart where digitalis was not quite appropriate; and even in Stokes-Adams disease. Less expensive but not quite so efficacious are the newly separated principles of valerian (bornyval, valyl, etc.), given in capsules after meals. These drugs, castoreum especially, or a cup of black coffee, are effective aids when the patient has overdone himself somewhat, and has to lie down rather faint, with faltering rhythm and dull pain in the cardiac area. They (except the coffee) are useful also in "functional" cases.

Venesection.—Nothing can seem more rational than from an engorged venous system to withdraw some 10 to 15 ounces of blood. Unfortunately to bleed from the jugulars is not an easy matter, yet it is from these veins that the relief to the right side of the heart would be most directly attained. To bleed from the arm, however, generally gives relief, even striking relief, for the moment; the distress is mitigated, the face regains its color, and the heart's action improves, probably by emptying the coronary veins; too often, however, even in a few hours these ameliorations evanesce, and the patient is little or no better than he was before the operation. I do not remember to have witnessed, either in pneumonia or in heart disease, any crucial result of venesection—such, that is, as to save life, or even substantially to prolong it, but others have been more fortunate, and it is our duty in grave peril, especially in mitral stenosis, to give the patient the chance of its succor. If a fairly good heart—say in rheumatic mitral disease—be so palsied by overdistention that it cannot even under digitalis get a grip upon its contraction volume, venesection followed by digitalis is certainly a rational method. For my part, whatever the cause of engorgement of the right heart, I now advise full venesection very rarely, but small bleedings often; these, if they have a less striking effect at the time, are acceptable at an earlier stage and coöperate

to a more permanent amelioration. It is difficult to explain how the removal of 3 to 5 ounces of blood—by leeches, for example—acts to this advantage, but that it does so I have no practical doubt. And the trivial operation can be repeated, and with no diminishing advantage, time after time, which, in chronic cardiac disease, is no slight recommendation. It is usual to place the leeches over the heart or liver, and the liver may, perhaps, be thus directly tapped; but the place of the bleeding, perhaps, does not really matter much. I suppose that if strychnin is being administered it would be well to apply cupping glasses rather than the living leech, but I am not aware of any experiments on this point. Some bold practitioners do not hesitate to aspirate blood directly from the liver itself, an audacity not yet justified by definite results. How beneficial bleeding piles may be in cases of plethora, whether venous or arterial, we know well; as well as we know the mischief which may be wrought by them otherwise: under convenient circumstances, therefore, we may bleed by leeches from the anus with much advantage. Bleeding is strongly recommended when pulmonary edema is urgent and the sputum is frothy and perhaps blood stained, and especially in acute pulmonary edema. Barié is very decided about this remedy.

Instead of a "wet" method the practice of dry cupping is better fitted for some patients, a procedure which, indeed, has more effect than one might have supposed: and this insignificant application may be used at will. In pulmonary engorgement it is usual, of course, to apply the cups to the back of the chest, and apparently with advantage; but whether the precise site of the application is of great importance we scarcely know. A large poultice upon the chest has probably the same effect, with the additional advantage, in some cases, of the comforting warmth. The weight of a poultice and the fatigue of its application and renewal have led to too much neglect of a therapeutic means which, when practicable, is very useful.

When from primary heart disease we turn aside to cases of high arterial pressure my experience is very different. To bleed these persons once or twice a year is a most beneficial practice.

Quinin has some good effect upon the heart—in "toning it up." It is more frequently used in combination with other drugs—such as digitalis or squill—rather than alone; though as a tonic in convalescence it may have its place. The hydrochlorate is better for general use than the sulphate. In combination with such drugs as the above, its effects are often manifestly for good; especially, perhaps, in old dilated hearts. For such a purpose the doses for a short time may be large; that is, 2 to 5 gr. It is usual to give substantial doses also in malignant endocarditis.

Arsenic is not to be disregarded because its action is obscure; it may consist in a promotion of oxydation, and thus assist the heart when its energies are flagging. As the outflow from the coronaries is in proportion to the consumption of oxygen in the heart (Barcroft), we use arsenic empirically and with success in cases in which we have reason to sus-

pect slow myolysis. Its use should be in small doses and the courses intermittent. In the treatment of angina pectoris arsenic has assuredly some beneficial effect. (See formulas on p. 163.)

Barium chlorid I have little experience of; and tentative administrations of it have not led me to desire a greater familiarity with it. That it raises arterial pressure, apparently both by peripheral constriction and by cardiac reinforcement, there is no doubt, and there may be still a part for the drug to play when we understand it better. For some reason it is rarely well tolerated. As its constrictive powers seem to be exerted upon the bronchial musculature it may ward off pulmonary edema. If it increases the cardiac tone and systole at the expense of the pause, it must be avoided in decaying hearts; and for sound ones we have other and more convenient remedies. Nevertheless, if we have reason to suppose that the residual blood in the ventricles is large and the heart capable of response to stimulation, occasional doses of barium chlorid (say gr. $\frac{1}{6}$) may help us at a pinch.

Periplotzin—a glucosid from an Asclepiadaceous plant—is said to have the virtues of digitalis without its vices. I have not been able to get any definite clinical experience of it.

Apocynum cannabinum and **A. androsæmifolium** have the same virtues, which depend on the active principle of both, named cynotoxin or apocynamarin (Dale and Laidlaw). The drug is very powerful, but its qualities are somewhat too oblique for medical use—at any rate, in heart disease. It has, for instance, more effect in vasoconstriction than either strophanthus or digitalis, which stands between the other two in this respect, and also in respect of irritation of the stomach—an effect of apocynum which almost forbids us to prescribe it. Could this evil be avoided, apocynum might be very useful for vasoconstrictive purposes. Dr. F. Shattuck reports some good effects from his trials of it. Under its use the arterial pressure rises very high—another effect in which digitalis stands between it and strophanthus. On diuresis apocynum has only an indirect influence. I need not dwell any longer upon a drug which, as a remedy, has not as yet been domesticated.

Camphor is a drug of which I have not very much personal experience; though if all that is said of its virtues be true, or half true, it is an agent not to be overlooked. It is said to be useful just in the very cases where we need assistance; namely, in fevers and cases of heart failure where immediate effects are desired. Doses of 1 to 3 gr. are given at frequent intervals, and some writers give considerably larger quantities. As it is not readily absorbed, in urgent cases, when better known remedies fail, it is to be administered as a hypodermic injection of 1 gr. in 15 minims of sterilized olive oil every two or three hours:

℞. Camphoræ ..... 3 pts.;
Olei amygdalæ ..... 12 pts.;
Ætheris ..... 8 pts.—M.

S. For injection deeply into the subcutaneous tissue or into a muscle.

It is said to act as a cordial to the nervous system and especially to the cardiorespiratory centers. The little one knows of camphor would suggest that by the mouth in substantial doses it would upset the stomach; probably in hypodermic administration it is better tolerated.[1]

Of other drugs to which specific virtues as "cardiac tonics" are attributed we have no definite knowledge, not even of an empiric kind. Sir R. D. Powell is not alone in thinking convallaria useful; I find cactus grandiflora is of service in functional cardiac disease; spartein has its advocates. Much work, however, both pharmacologic and clinical, has yet to be done with these agents before any recommendations concerning them can be formulated.

Opium.—On this valuable agent I am tempted to quote some part of an article I wrote in The Practitioner for 1869: this I do the more readily as the opinions I then published have been corroborated by many eminent physicians, and I have seen no reason since to modify them. My paper was on the value of morphin, hypodermically injected, in the distress of heart disease. Nearly forty years' experience of this remedy has convinced me of its value, and I am surprised that it is still so little resorted to. Here and there a physician testifies to its effects, but the recognition is rare, and in general practice few physicians seem to venture upon the use of it. I then wrote, "Morphin is most useful in angina pectoris, mitral regurgitation, and dilated heart; less valuable in mitral stenosis and in diseases of the aortic valve; though in aortic regurgitation, where the big heart is vehemently pumping, it is occasionally helpful. In 'irritable heart,' also, it gives much solace, but morphin must never be used in cases where a craving might be established; in mitral regurgitation, however, with its train of distressing symptoms—orthopnea, sleeplessness, precordial misery, dropsical unwieldiness, and utter weariness, when relief of the stomach and (a purin-free) diet have been tried in vain—we need not be deterred by visionary moral apprehensions. The dose should be given in the evening, and the room kept absolutely still. After the injection—and the first in an adult should not exceed $\frac{1}{8}$ gr., to be carefully increased, if necessary, to $\frac{1}{4}$—the face becomes less turgid and its expression calmer; the heart more tranquil and rhythmic. The quick, shallow, anxious, often tidal cardiac dyspnea gives way to a deeper, slower, and easier respiration; the cough abates, not so much from reduced sensibility as from relief of undue excitement of the bulb by carbonized blood; and the patient, who for days has been tossing in misery, falls into the first quiet sleep perhaps he has enjoyed for weeks. In the cases I am describing the drug does not disturb the stomach; distress, like pain, seems to 'carry it off'; and, if the morphin be given every other night only, the muzzy stupor of the cyanosis so far from being deepened is dispelled. Furthermore, if the drug does not exercise, as it seems to do, a tonic effect on the cardiac muscle, assuredly its effects are more than consolatory; so far as such cases admit of cure they are curative. Such an injection, given

[1] For a full account of the effects of camphor on the circulation, with bibliography, see Winterberg, in Pflüger's Archiv., 1903.

every other night during a critical week, often restores the balance of the circulation, calms the nerves, averts the starts which scare away sleep, and gives better advantage to the more specific means of treatment. If there is fair breathing room in the lungs, neither a moderate degree of edema of their bases, cyanosis, nor abundant venous albuminuria contraindicate the use of the morphin in this manner, for the excitement, into which the respiratory center is harried by the carbon dioxid, is probably factitious; but the presence of chronic renal disease, as revealed by granular casts, would impose at least great hesitation in its use, though for the seizures of high-pressure dyspnea it may be the only resource, and the risk must be taken. In cardiac delirium I then spoke of it as ineffectual and sometimes baneful, but latterly I have seen marked temporary relief from it even in cases of rapid irregular pulse and congestions with much cardiac delirium." I would add that in favorable cases the pulse becomes stronger, steadier, and slower; the urine, therefore, flows more copiously, the edema subsides, and the extremities grow warmer.

It is needless to say that in great straits to administer any potent remedy is a matter of serious responsibility; too often we have to refrain from a thrust in the dark. Nevertheless, the opportunities for the hypodermic morphin are many and favorable, and are not to be set aside on mere speculative grounds. On such grounds the late Dr. Hyde Salter and many other distinguished physicians earnestly withstood my resort to morphin in cardiac dyspnea; and on no better grounds a distinguished therapeutist proclaimed the other day that "its use is simply fatal. It is all the patient can do to maintain the respiration by the most energetic voluntary efforts: arrest these efforts by morphin and the patient will sleep—but it will be the long dreamless sleep which knows no awakening." In pneumonia this caution is too true; but in heart disease my answer is, "Do not argue, but try—with discretion."

Such being my opinion of morphin in heart disease I was the more pleased while I was engaged in writing this article to read the tribute to it from the pen of Professor Musser,[1] from which I extract the following sentences: "In cases of weak heart consequent upon exhausting disease, or after prolonged mental or physical pain, opium is useful (even) where there is no organic valvular or muscular lesion. In patients with failing compensation, especially in those of excitable temperament, and in the gradual engorgements from dilatation, opium steadies and supports the heart. . . . A case of myocarditis with restlessness, Cheyne-Stokes' respiration, dyspnea, and rapid pulse, was much helped by continuous administration of opium." Three years before Dr. F. J. Smith had written[2] that "morphin is one of the most valuable cardiac tonics we possess, especially in the production of sleep; $\frac{1}{8}$ gr. under the skin rarely fails to give a restorative sleep. I cannot make out whence comes the dread of morphin in cardiac distress that I find so universally entertained by practitioners."

[1] Amer. Jour. Med. Sci., Jan., 1906. [2] Clin. Jour. Nov. 4, 1903.

Dr. Cheadle, Dr. Babcock, Dr. Stein of New York, Dr. Mitchell Bruce, Dr. Gibson of Edinburgh, Prof. Frantzel, Prof. Baümler, and other eminent physicians have given like testimony. Dr. Cheadle in critical conditions prefers "moderate doses by the mouth." In the tropics Dr. Carnegie-Brown finds the "remedy, apart from its sedative effect, prompt and certain as a restorative of cardiac tissue, even over long periods of time," and finds it efficacious in the "desquamations of the myocardium." An old friend wrote to me, in 1905, concerning the illness of a well-known statesman, that "in his state of dusky skin, dyspnea, and torpid state he dared not have given morphin had he not read my original paper"; under its use the patient "rallied bravely." Fränkel, in an interesting speech on insomnia,[1] after saying that morphin in cardiac distress "eine ausserördentliche grosse Rolle spielt," added that sometimes it answers better in association with heroin, or in alternation with heroin. In some cases he had given morphin and heroin in combination subcutaneously. In others he had done better with scopolamin and morphin, also subcutaneously.

At the same time we shall not forget that the part to be played by morphin in cardiac distress must, as a rule, be incidental and temporary. In many of these cases of continuous dyspnea there may be some hyperglycemia; so the urine should be tested systematically for diacetic acid and its congeners, lest we add the coma of morphin to that of "acidosis." While morphin is being used the carbohydrate elements of the diet might be reduced; and some caution should be observed if pulmonary edema be extensive. Cheyne-Stokes' breathing is no deterrent, but both for this symptom and for cardiac delirium we have other remedies.

Of the *milder hypnotics*, chloralamid is, in my experience, the safest and best; but it suffices only in cases without much distress. Veronal in solution, as in a cup of weak tea, does well in cases where not more than 5 gr. is required, but in larger doses its toxic qualities begin to predominate over the hypnotic. Dr. Morison says that the application of ice to the head conduces to calmness and repose, especially if the heart be excitable. And this end has often to be sought in measures addressed to the stomach, such as bismuth with carminatives, or in cachets of salol. If flatulence be the cause of agitation, a few drops of chloroform or of an essential oil, even of turpentine, in a little mucilage, may dispel it. A combination of bromid and caffein is often useful. The bromids are, of course, ready and harmless agents of tranquillity in nervomuscular restlessness, but must not be given in depressing quantities. These salts are especially useful in the "functional" phases of cardiac disorder. Common salt should be reduced during their use. In all cases with edema this precaution is important. Chloral is an excellent remedy for cardiac insomnia, but the physiologists have proved to us that in feeble heart its use is not without peril. It may be used safely in hypertrophy, as in granular kidney. In cardiac delirium Sir Richard Powell recommends hyoscin; and theobromin is occasionally very effi-

[1] Verein f. inn. Med., Berlin, Feb. 17, 1908.

cacious, even in high-pressure cases with arteriosclerosis (see Oxygen, below). A cupful of tea will, as is well known, often act in this paradoxic manner; the stage of excitement being soon followed by sedation. Or possibly in certain states an excitement of controlling centers may reduce subordinate unruliness. Strychnin, however, is often a cause of renewed cerebral fret, and during such periods should be excluded from our therapeutic scheme. It is said that in atonic cases pituitary extract promotes sleep.

Oxygen.—The effects of this gas in cardiorespiratory disease are unquestionable, and least questionable by the patient, who often clings to his oxygen pipe with pertinacity. The gas may enrich the blood supplied to the heart; or a large part of its beneficence may be by relief of the medulla worried by cyanosis. That the gas does relieve the cyanosis may be proved by consequent falls of the red corpuscles, from 5,500,000 or 6,000,000 to 4,500,000 and under. But its good effects are not confined to cases of dyspnea; in anemiated, atrophied, and failing hearts and in low delirium with dyspnea, perhaps with hyperglycemia, it is often, if not a substantial ally, at any rate a palliative of no slight importance, possibly by reduction of blood viscosity (Bence); or it may act by assistance to the kidneys, which, on Brodie's estimate, consume 25 per cent. of the oxygen inhaled. Unfortunately, oxygen has been expensive and cumbrous in application, so that we have postponed its use till other remedies have been tried and have failed, and the patient's condition has got worse and worse. Recently a portable and inexpensive oxygen-making apparatus has been designed by Prof. L. Hill, which seems likely to be more convenient. Haldane has shown that dissipation of carbon dioxid is far more important than addition of oxygen, the intra-alveolar tension of which may be lowered by one-half without altering the depth or frequency of the respiration, whereas an increase of only 0.5 per cent. of carbon dioxid in the bulbar circulation will double its excitability.

By the administration of pure oxygen, or of air containing over 2 per cent. of carbon dioxid, Cheyne-Stokes' breathing may, as a symptom, be mitigated or suppressed. In this condition the respiratory center, by some lesion or adverse state, has become too obtuse to the stimulation of the dioxid, which therefore accumulates excessively until the torpid center is aroused to an activity so vehement as to accumulate oxygen to a corresponding extreme, whereby the medullary susceptibility is abated still more. Now to administer the carbonized air prevents this abatement of the medullary reaction by the waxing periods; while conversely, to administer pure oxygen, by maintaining the disengagement of dioxid in the blood at a stimulating value, prevents the waning periods. Moreover, by a more continuous use of the oxygen we may not only prevent the waning and waxing—that is, the rocking of the vessel between extreme points—but, by keeping a steady way on, hope that the torpor of the respiratory center may prove to be temporary. Recovery, complete recovery, from states involving intense or prolonged Cheyne-Stokes respiration, is fortunately no very infrequent event.

Purgation is a method which I think is, or used to be, carried too far in heart diseases. In accumulation on the venous side we cannot dispense with laxatives, but I have never seen anything but evil from the more drastic degrees of purgation. Even in large dropsies in strong men the end we desire is better attained by gentle mercurials, sulphur, senna, colocynth, or salines, than by elaterium and its like. Sulphate of soda is the best of the salines. This and all salines should be given in small quantities of water—not more than 4 ounces. If one of the ounces be of glycerin they may be administered per rectum. Pulvis jalapæ composita is an excellent laxative in hospital practice, but private patients are apt to regard it as rather a dog's dose. Intestinal reflexes are apt to upset the heart, and as a routine a morning enema is, perhaps, in every case the best relief.

Diuretics.—In heart disease with high venous pressure we often feel that to achieve a good diuresis is more than half the battle; indeed, some of our best medicines will not act efficiently until diuresis is established; or by diuresis their own success is signified. Yet at the same time we feel also that our means to this end are almost wholly empiric, and that diuretics are all peculiarly capricious. We are baffled at times to see anasarca persist, and a very solid anasarca, in spite of a good diuresis. As yet the pharmacologists have not satisfied themselves as to the modes of action of many or most diuretic drugs; for instance, as to the parts played by arterial pressures, by the peculiar endowments of the kidney parenchyma, and, less directly, by the liver and other correlated organs. Does mercury, for instance, promote diuresis by reducing venous pressures in the portal system, or by arousing or favoring the peculiar activities of the liver and colon, or by a resultant of both these or other factors? How is it that digitalis, so efficient in cardiac disease, has no diuretic effect on the healthy man? How far, again, by the management of salts in the blood can we govern the processes of osmosis? Again, the general state of the patient and the stage of the disease are important variables.

When, as not infrequently, we have done our best to readjust the balance of the circulation, and even with some apparent success, yet the discharge of urine does not respond to our desires; when venous pressures are high, and the urine scanty but concentrated and albuminous, nothing can be worse practice than to force a congested kidney; active diuretics may do more harm than good. But, on the contrary, anuria may depend on low pressure in the renal arteries, or even on some torpor of the kidney; and it is in such states as these that diuretics are often strikingly effective. To endeavor to promote diuresis by abundance of water drinking can very rarely be appropriate, for to increase the bulk of the blood is to throw heavier volumes of it upon the ventricles; and it would seem that in heart disease the kidneys stop rather for lack of specific constituents of excretion than for lack of the aqueous vehicle; their vessels may be full to repletion and yet diuresis tarry; moreover, the practice is not justified by results. Both for the stomach's sake and for economy of the blood the volume of liquid should be restricted to the amount

necessary for the comfort of the patient; some by old habit are thirstier souls than others. The recumbency, rest, and warmth of bed favors diuresis, as the records of all our hospitals show; and diuretic drugs should not be administered until after the effect of these conditions has been noted. Some of these drugs have been discussed in other paragraphs.

In dropsy the effect of *withholding salt* from the diet must be tried: a simple means which, not infrequently, has an astonishing success, though we do not yet know how to distinguish precisely the conditions under which it succeeds. We are far from a solution of the problems of diffusion, dialysis, and osmosis. In osmosis the membrane is not passive; it exercises some selective action, but the relations of fluids and tissues are very obscure, and failure may depend upon some dystrophy of the membranes. In cardiac disease, speaking generally, there seems to be a retention of sodium chlorid; and the method is to withdraw salt from the food, during the first four or five days gradually. At first only the salt on the table is forbidden. The next step is to reduce the salt in the dishes, the bread and butter, etc., so that in four or five days more all salt is rigorously excluded. This total exclusion is tolerable for another four or five days, when a little salt may be added to the cooked food or to the bread, and so gradually a return made not to ordinary quantities of salt, but to so much as may be really necessary. Some persons take much more salt than is really required, and in one or two of them I have noticed that the effect of the withdrawal was more conspicuous. In a successful case it is almost magical; before diuresis becomes very manifest, the limbs shrink, the puffiness of the face and other parts which had not, perhaps, been very noticeable, becomes conspicuous by its departure; and, as diuresis is established, the patient attains a slimness of outline in body and limbs which he had never dreamed of; in elderly patients, indeed, the withering of age may become almost pathetically apparent. To a late medical friend of mine, supposed to be ill of "pernicious anemia with dropsy," I advised by letter (I never saw him in his illness) a trial of the no-salt method. His back and loins were boggy, his thighs distended, and the skin stretched and shiny. He passed eight days of absolute salt deprivation, and "the result was remarkable and unquestionable." The urine exceeded the calculated intake of water, and the drospy disappeared, so that it took "ten hours sitting up to show any perceptible refilling, and this only about the ankles." The "saltless diet, however, became intolerable," and was modified. As the diuresis is consequential to the altered currents of osmosis, while we are excluding common salt we must be careful to see that homologous saline constituents are not prescribed in the medicines. By urinary analysis it is said[1] that the dropsy may be observed to vary inversely as the excreted chlorid. In some cases the deprivation does not attain its purpose, and as yet we are unable to discriminate between the conditions of success and failure. In successful cases not anasarca only but the effusions in the great cavities

[1] Achard and Laubry, Soc. méd. des Hôp., April, 1902.

dwindle also; and the patient, who for weeks may not have known a night's rest, tranquilly lies down to sleep. Thus, if this treatment works no direct good to the injured parts and organs, the disordered functions enter upon a phase of relief and peace which gives us time and occasion to promote more permanent means of amendment. In all cardiac conditions disposing to edema, then, we shall advise restriction of salt as a habit; salted foods and soups should be forbidden, and the salt cellars left in the pantry.

Dr. Tyson, of Philadelphia, in cardiac dropsy cuts down both drink and food—say to 3 or 4 ounces of milk every two hours. Absorption of fluid from the tissues serves to keep hunger at bay. As soon as hunger awakens he "grudgingly" increases the food. Patients who are eating freely, he says, do not answer to diuretics.

Of drugs for diuresis in heart disease *mercury* is one of the oldest and best. In cardiac dropsy it has been recommended by Baillie, Stokes, Watson, Trousseau; and recently emphasized by Broadbent, Jendrassik, and many others. By some physicians it is used only in combination, to enhance the effects of other associated drugs, as in the combination with squill and digitalis:

℞. Pulveris digitalis recentis..... gr. ss–j;
Pulveris scillæ..... gr. j;
Massæ hydrargyri..... gr. j;
(or Hydrargyri subchloridi..... gr. ss–j;
Confectionis rosæ..... q. s.—M.
S. One pill to be taken every eight hours.

but it has always made good its claims to virtues of its own as a dispeller of cardiac and hepatic dropsies. It may be prescribed as calomel, in repeated small quantities—such as $\frac{1}{4}$ to $\frac{1}{2}$ gr. daily or twice a day for some days, or as blue pill. There are also moments of acute portal engorgement when either of these drugs may be administered in larger doses—5-gr. doses of calomel, for instance—with immediate alleviation. Such hard hitting is, however, only occasional; for diuresis the fragmentary method is better adapted. Perhaps calomel, if well borne, is the more efficient; but, even if combined with a little Dover's powder—

℞. Hydrargyri subchloridi..... gr. iij;
Pulveris ipecacuanhæ compositi..... gr. ij to iij;
Sacchari albi..... gr. v.—M.
S. For intermittent use.

—it scours or gripes some persons who can tolerate blue pill well enough.

The influence of mercury may be something more than a change in the mass relations of the bodily fluids, for it is often effectual in removing the "bilious" discomforts of excessive arterial pressure, perhaps by neutralizing or dispelling certain purin bodies or cognate metabolic poisons. For such persons, even when apparently little able to bear such treatment, a grain of calomel may have a remarkably alleviating and even "tonic" influence. If care be taken to keep the mouth pure, especially if it be "dry," mercury may be used

in fractional doses for successive days without ill consequences, and with much advantage in removing congestions and releasing the secretions. Needless to say, the drug must be either withheld or most cautiously used where the kidneys are not fundamentally sound; this is a rule of theory as well as of experience, if it be true that mercury acts on the epithelium of these organs. Often when digitalis mixtures fail or are failing, an interlude of mercury will enable the foxglove to resume its wonted efficiency. On the saline diuretics—on nitrate and acetate of potash and the like—we need make no delay. These salines are said to produce a more complete urinary excretion; and it is of interest in the course of a long case to compare the urines due to the several diuretics in respect of their solid constituents. There is some evidence (L. Brunton, M. Hay, Steward) that soda and magnesia sulphates increase blood-pressures.

On Tapping Dropsies.—In the more extreme stages of failing heart with high venous pressures, the distresses of those patients who unhappily are doomed to fight out the malady to the bitter end, are so urgent that even desperate means of relief are prayed for. *Pax illis cum morte solum.* Death itself is better than nights and days of fear and pain; and a hazardous remedy better than a too careful acquiescence. The duty of the physician is to prolong the life of his patient to the uttermost, though he may silently think with those about him

> "O, let him pass: he hates him
> That would upon the rack of this tough world
> Stretch him out longer!"

In such a state of things temporary alleviation may be given by operative means. Too often fluid is left in one or both pleural cavities which might have been drawn off, much to the solace of the panting sufferer. The puncture is nothing, and the fear of septic change remote, even under no extraordinary precautions. Here the dilemma is not very perplexing.

Nor need we shrink from paracentesis in ascites if the abdomen is much distended; the collection of moderate quantities of fluid in the flanks is no very disturbing matter, and of large ascites I think we see less than we used to do, even in mitral stenosis or adherent pericardium, perhaps because of the more temperate habits of the people. A full peritoneum adds much to the embarrassment of the patient, and its evacuation is easy enough; the difficulty is, of course, to prevent rapid reaccumulation, for repeated tappings are followed by gravitation of the venous blood into the vacant room with symptoms of collapse; and in these cases, *e. g.*, in adherent pericardium, the liver is often large and hard (H. D. Rolleston, Wenckebach). To avoid this, and to prevent fresh exudations, the abdomen must be supported from without; this is best done on the old plan of placing a pad upon it, and securing this in position by stout strappings. A binder soon gets dislodged, and a corset stops abdominal respiration. Sometimes, after one or two tappings the fluid does not reaccumulate; the vena cava behind the liver may get

released, the diaphragm descends and the lungs fill better. The relief of cavities, then, is no serious difficulty; the graver responsibility meets us in regard to tapping of the legs. To tap the legs has two purposes; when the drainage is free the solace to the patient is wonderful, and to leave the limbs subject to the enormous weight of a large dropsy is to ensure, if life be spared, an inflammatory destruction of the skin at any rate, and not rarely a mortification of the extremities, attended either with a miserable aggravation of sufferings already almost intolerable, or with the false peace of a gangrene. When moisture exudes upon the legs we have waited too long; but to operate is to run other risks which, if not so great, yet in case of ill issue have not the excuse of being inevitable. The alternatives must be laid before the friends—the patient himself is rarely in a state for perplexing decisions—and the responsibility shared with them. If it be decided to interfere, the choice of methods will remain with the physician, and the choice is no easy one. As in case of spontaneous rupture of the skin, so in operative interference, an aseptic dressing is practically impossible. Still by operation the site of the issue can be selected and, at any rate for a time, restricted; and in cardiac disease the exuding fluid is less irritating than that of kidney disease. Southey's tubes are ill tolerated by sufferers who, in incessant restlessness and in the fretful moods of disease, shift and toss. Unless quiescence can be anticipated, it is better to try other means; and this the more as the tubes are apt to block, or the parts under puncture to seal up. The discharge from one set of punctures does not usually last long enough to secure an ample and continuous discharge. And the punctures, small as they are, are by no means safe from erythematous inflammations. Dr. F. Shattuck says he prefers a larger trocar—"one of fair caliber," thoroughly sterilized (and the skin likewise), which he thrusts an inch upward into the subcutaneous tissue. He then packs it round with sterile cotton or gauze, keeping the skin as dry as possible, and connects it by tubing to a receptacle under the bed. He has thus drawn off 144 ounces in a day from a puncture in each leg. These methods will be tried first; but on the whole, I think, dire as these alternatives are, that a bold incision with the lancet, an incision of 2 inches in length on the dorsum of the foot or behind the inner malleolus on each side, is attended with little more risk than the punctures, is more easily submitted to such antiseptic attention as may be practicable, and offers incomparably better and more continuous drainage. Whatever the means, the legs must be well anointed with an antiseptic oil to shed off the drip of the fluid.

The earlier attacks of dropsy ought to be detected while it is only dropsy of the blood; that is, before the fluid exudes largely into the cellular tissue. The increasing weight of the patient ought to dictate active diuresis and the like, and an economy of fluid intake; for it is said that the blood mass may be rising to even double its volume before dropsy becomes obvious, the heart meanwhile being grievously burdened. The numeric relation of red corpuscles, if constantly watched, would approximately indicate dilution of the blood. As blood volume rises and oxidation is reduced these bodies increase compensatorily, still

these relative changes are not quite parallel, and from their fluctuations some inferences as to treatment might be made.

Milk may be considered partly under the head of diuretics, as among the many recommendations of it during the last few years this virtue has been reckoned as one of the chief. We have to ask ourselves, however, if these recommendations have not been rather overdone. It is intelligible that as a pure, bland, and apparently light diet milk should be excellent; and it often acts beneficially on patients previously submitted to random and loaded if not toxic feeding. After abundant beef-tea and port wine, milk may be angel's food. Still, when now we see patients with heart diseases fed on large quantities of milk—and not children only but adults also who are less able to digest it—we may suspect that the other extreme is in sight; that we may even get instead of a "beerdrinker's" a "milkdrinker's" heart. Moreover, on the full milk diet the patient consumes a good deal of salt. I suspect that the virtues of milk in heart disease are of the negative kind; excellent as a relief from a diet rich in extractives and alcohol, it is too liquid to be an ideal diet when the heart is laboring, already, under a larger load of fluid than it can well lift. Even as a diuretic its virtue is probably negative; that is, by deprivation of extractives and heavy nitrogenous metabolisms the blood is purified and the scavenger organs are relieved. The drawbacks of a milk diet are that in the adult it is not so well digested as in the child, it throws too much fluid into the blood, which in heart disease is often enormously augmented in volume already, it promotes constipation, and is said on rather uncertain grounds to favor thrombosis by its calcium constituents. On grounds no less abstract calcium salts are said to be nutrient to the heart. The so-called Karell cure is designed to obtain the catharsis of milk with a relief of liquid volumes. The fluid limit is 1½ pints per diem. At first this is given, for two or three days, as milk only, 6 to 7 ounces at 8 A. M., 4 and 8 P. M. This is the most trying part of the method. Then 1 egg is given at 10 A. M. and a biscuit at 6 P. M. for a couple of days. Then 2 eggs with bread, and a little minced meat are allowed. In twelve days the patient returns to a careful ordinary diet, the fluid being still kept down to 1½ pints, but not necessarily milk only. About the third day diuresis sets in for a short time, the dyspnea is relieved, the pulse improves, and the edema subsides. This method is said to be indicated for weak hearts for which digitalis is less appropriate.

Diaphoretics.—The effects of diaphoretics are, in my experience disappointing. What can promise better than the endeavor to relieve and purify the burdened system by a kindly sweat, the natural alleviative of our healthy toils? To speed the venous currents in mitral disease, or to relax the tension of a bursting arterial system, what can promise us more than such a gentle exhalation? By drugs, by hot air, by vapor, by packs, by Turkish baths, and other methods we can produce the perspiration; we can count on it better than on most other therapeutic interferences; but it does not do the good we were hoping for. The patient, after the first two or three baths, begins to sweat well enough,

but he is not a pin the better for it; probably, indeed, he will report himself as "weakened" by the operation; and if repetitions of the bath or drug procure him some better tolerance of it, the result is not satisfactory; indeed, the method makes too heavy a demand upon the heart itself. Even in renal disease the remedy, if such one may call it, of diaphoresis is as a method ineffective, although no doubt in acute uremia swift and copious diaphoresis helps us occasionally. The best kind of hot-air bath is that in which electric lamps are employed; where the electric current is available it is cleanly, safe, manageable, and efficient. If there be substantial heart weakness, pilocarpin, whatever its advocates may claim for it, is a dangerous agent; unless the heart muscle is sound it must not be ventured upon, for under its use fall of pressure and collapse may appear suddenly. In health it is probably not the sweat only which assuages us, but the changes of which the sweat is one—the exercise, the dilatation of the arterioles in the vast muscular and cutaneous areas, the compulsions of the lymph and secretions. Still, as a means among others, we must not altogether neglect a method which, used in moderation, must make for relief, and may well be employed with exercises and other recuperative means. Apparatus for stimulating the heart, as, for instance, in pneumonia or faint, by applying hot air to this part of the chest are described; I know nothing of their advantages.

Iron in diseases of the heart is an important detail of treatment, but one which it is difficult to put into an abstract rule. In cases of accumulated venous pressures it is rarely appropriate; it is apt to lock up secretion and excretion, and to disagree with the stomach. Still, even in mitral diseases, there are moments when such a blood restorative has its openings. Its use, however, is more frequently seen in aortic diseases, when it is of prime importance to supply rich blood to the laboring left ventricle, and in mitral reflux rather imminent than active. Still, aortic patients, for some reason, are prone to bilious derangements, and if iron be administered it must be watched carefully.

Iron is useful in degenerative affections of the organ, in the defect of its muscle. In some of these cases when anemia seems to be the source of the deterioration—and such cases are not a few, especially in women drained by menstrual or hemorrhoidal discharges, or frail elderly women with "weak hearts"—iron plays a leading part. And in all cases of intimate atrophy of the cardiac muscle, as opposed to mere adiposity, iron is, on the whole, a safer and, generally at least, as efficient an agent as the more favored arsenic. For a week or two, however, from time to time, a little arsenic may be added to a longer course of iron, often with much advantage. I need not say that those precautions in respect of the gastro-intestinal functions, which it becomes us always to observe during the administration of iron, apply still more strongly in case of cardiac disease.

Electricity.—In the treatment of diseases of the heart, as in too many other diseases, electricity in its various forms is disappointing. When the subjective impressions are estimated and deducted, little

balance of benefit remains. At various times—though not for the last few years—I have submitted cases of heart disease or disorder to skilled and sanguine electricians, but, suggestion apart, with no encouraging results. Static electricity, faradic electricity, and galvanism whether applied to the heart itself or over larger areas of the body, have proved themselves helpless. Galvanization of the "sympathetic" in the neck will certainly reduce the frequency of a hurrying heart for the time, but the effect is transient, and not cumulative. It is said that to pass a faradic current into the water of the bath may replace gas or saline.

But some reservation I am disposed to make concerning "high frequency." I have seen excessive arterial pressures considerably reduced during a course of this kind of electricity, especially in two cases attended with stenocardia, or angina minor; but I shave not yet been able to obtain any adequate number of manometric records of its effects in patients not using any other means of treatment simultaneously. It is said to produce large peripheral vascular dilatations, especially of the upper limbs, attended with notable rise of surface-temperature, which does not very rapidly subside; effects which are in the right direction. Rumpf, of Bonn,[1] on two years experience, goes further, and says that in high-tension oscillating currents we possess a powerful cardiovascular tonic. Time after time, by physical signs and especially by orthodiagraphy, he has observed the heart's diameter thus shortened, while the beat rate was reduced, rhythm steadied, the output per beat and minute increased, respiration deepened, and palpitation soothed. No drugs were given during or near these trials. He seems to attribute these results to the vagus, not a very convincing explanation. Of 68 cases, 39 improved decisively, 16 considerably, and 11 permanently. No blood-pressures are given. His best results were in middle-aged men with dilated hearts and dyspnea, and of these the best were in cases without arteriosclerosis. Many of the amendments took place in cases in which all previous means had failed. The position of the diaphragm was carefully noted in all. Of 10 neurotic cases, 4 only were benefited. The author had four large accumulators on his house-supply, most carefully insulated conductors, and a platinum interrupter with two ampères at the rate of 500,000 to 1,000,000 in the second, making a spark of 50 to 80 mm., equal to 10 to 12 volts. One pole (metal) was put under the shoes; the other, a tin-foiled glass bulb (?) ("mit staniol gefüllte Gasflasche"), was carried, labile and stabile, over the heart. The sittings were from six to ten minutes every other day, or every day, for four to six weeks. The method is of no use in renal cases.

Baths and Exercises.[2]—In discussing the value of baths and exercises on heart diseases—there is no essential difference in their effects—we must approach the subject with rather less entanglement of terms than is often the case. We must not dwell too much on the name of the patient's disease; we must discover what baths and exer-

[1] Deutsch. med. Woch., Dec. 24, 1908.

[2] These means are not to be fully described here; they are discussed by Dr. McKenzie in Volume I. of this work with other physical methods of therapeutics.

cises can do for the circulation, what elements there may be in the particular case indicative of the need for such service, and what reserve of energy remains in the heart to enable it to respond to such a call. For not in the bath and exercise methods only, but in all methods of cardiac therapeutics, we must regard our means as of three chief kinds—those which spare and soothe the heart, and those which solicit or revive it, and those which repair it. Rest is an example of the first category; digitalis, of the second; baths and exercises belong to the rebuilding kind; and if our demands oxertax the remnant of cardiac capacity, we shall exhaust the heart or overthrow it. By baths and exercises we are now aiming high, not merely as with drugs to call forth reserves, but to make new heart stuff, and to appreciate this possibility in grave cases, if a task of no little difficulty, is yet an imperative one; some approximate estimation we are bound to attempt. Baths should, at any rate at first, be confined to the neutral zone, to be neither notably cold nor hot. A bath sensibly cold or hot may give rise to oppression or palpitation. As a rule, treatment will be initiated by the methods of rest and medicinal alleviation, and, after we have thus lifted as much of the weight from the organ as possible consistently with the demands of the body in quiescence, then by means of the tests on page 66, and by general considerations of age, nutrition, previous history, and causation which need not now be reckoned in detail, we shall come to some judgment on the balance of the individual resources, both in respect of the heart itself and of the body at large. Rest in bed was no doubt carried too far by our fathers, who noted the good effects of it in hospital patients; but, paradoxic as it seems, I have less reluctance in ordering such a rest for a fairly sound heart in arrears than for a heart failing in its intrinsic quality.

Of the exercises my own experience is not inconsiderable; of the baths, it is less, and in this part of the subject I am guided a good deal by the opinions of other unbiased observers who have had full opportunity of watching the effects of the baths. Yet in comparing the opinions of others I must confess that there seems to be a deplorable lack of fundamental data for a sound judgment. Surely, before entering upon a research into the effects of baths of various kinds and of temperatures upon the sick body, we ought to be fortified with a careful physiologic study of their effects upon the normal body and heart; but such observations are few, and not very recent or complete. I may, however, refer to those of Brunton and Tunnicliffe,[1] of Edgecombe and Bain;[2] used more recently and directly, to the favorable reports of experimental investigation of the methods by Curschmann and Romberg. Again, in recording the effects of these means it is admitted that comparison by ordinary physical examinations is fallacious. The patient may be regarded as fortunate who has escaped the diagnosis of cardiac dilatation on an infallible method of percussion. For example, on the "Nauheim methods," it is, perhaps, from Dr. Alexander Morison that we have the most independent and careful opinions founded on a sufficient experience.

[1] Jour. of Physiol., 1894.

[2] Lancet, June 10, 1899.

Now, in discussion of aortic regurgitation, Dr. Morison says that these methods are inadvisable; Dr. Thorne, on the contrary, contends that in this disease they are useful, and he would prove or, at any rate, illustrate his contention "by the fall in blood-pressure which they bring about."[1] One presumes Dr. Thorne to mean a fall of systolic pressure, but this seems a hard saying. When and how in aortic regurgitation can a fall of systolic pressure be an advantage? In a few cases of aortic regurgitation I have watched the effects of exercises, and I must say that I have done so in the hope—a hope not altogether disappointed—of seeing a yielding systolic pressure not lowered, but supported. A fall of systolic pressure in the aorta in this disease is, generally speaking, a phase of peril, and one which it is the office of therapeutics surely not to favor but to avert. It is when the left ventricle is dilating and the systolic pressure falling that exercises under vigilant precautions may fulfil this office. So, again, in cases of "atheromatous arteries," it is otiose to argue in the abstract that in this pathologic state exercises are either good or bad; in involutionary atheroma, for example, with relatively moderate pressures, the heart is often good enough, not rarely excellent, and needs but little of our interference; but arterial stresses must be very cautiously ventured upon in elderly persons. The cases of atheroma in which baths or exercises would be required must be few; but if in the atheromatous stages of high pressures—arterial plethora—an enlarged and distressed but not degenerate heart begins to yield under the stress, baths or exercises are in principle reasonable; not infrequently, with the help of colleagues at spas, I have tried them, and, in strict subordination to other means which act in reduction of the causative hyperpiesis, have found them advantageous. Concurrently with these, the exercises reduce the frequency of the dilating heart, irregularities and intermittences are abated, and some symptoms, dyspnea especially, are mitigated. In angina pectoris, on the other hand, a disease in which every rise in aortic pressure is to be regarded with anxiety, such calls upon the energy of the heart can be rarely permissible, if ever. If in particular cases of angina the heart is faltering, its nutrition and rhythm must be fostered by other methods.

As to the Swedish exercises adopted by August Schott at Nauheim, all experienced observers are agreed that the treatment by exercises is seen to its greatest advantage in cases of mitral insufficiency in comparatively young persons; that is, in the injurious distentions of hearts which are not the seat of essential decay; but, of course, they are inadmissible for some time—say for six months at least—after the endocarditis has presumably subsided. But it is just in these cases that all rational methods are effectual, and it is not easy to say that cases of this kind do better at Nauheim than under systematic treatment elsewhere. Exercises would seem to be of considerable service in select cases of mitral stenosis, especially if the regurgitation, which is seldom absent, be a considerable factor in the case; but unfortunately in this disease we usually have to do not so much with an ineffectual right ventricle as

[1] Jour. Balneology, 1906, p. 77.

with pulmonary stasis depending on a mechanical compression and a high pressure in the coronary veins and sinus which is at best irremediable, and too often must be progressive. But the left ventricle in these cases is usually "underloaded," and baths and exercises serve to promote a better distribution of the blood in a malady in which drugs are too often ineffectual.

If the heart be perishing or deteriorating in its intimate fiber it is evident that provocative methods, if applicable at all, must be practised only tentatively; by a tentative proving, that is, of general principles upon the individual case. Generally speaking, in such conditions the methods of economy are to be preferred. Dr. Morison gives the same reasonable advice in extensive pericardial synechia. Notwithstanding, we may find some service in the Swedish strokings, flexions, extensions, practised at first, at any rate, by the physician himself, who will watch the pulse-rate, the current, the veins on the backs of the raised hands.

In functional disorders of the heart the baths or exercises often do good service, either by their direct effects or, more often perhaps, by their "suggestiveness and discipline." In "cardiac neurasthenia" and instability of the sympathetic system considerable advantage is often obtained under the discipline and encouragement of such resorts as Royat or Bourbon Lancy. Nauheim is rather a dreary place for these patients. I have found Royat suitable as to amenities, and the skilful application of baths and exercises; Bourbon Lancy is recommended by Dr. Leonard Williams. The methods are now in vogue at more than one British spa, but, speaking generally, in Great Britain the physicians in health resorts give too little personal supervision to the nicer processes of bathing or exercises; means too often left to the rule of thumb and personal convenience of the bathmen.

For the heart of influenza provocative means are not appropriate until convalescence is quite established; and in diphtheria they are out of the question. In strain cases, after a period of economy, gentle solicitations by baths or exercises often prove useful; for instance, in young persons recovering from overexertion: but they need very careful, skilful, and "opportunist" handling. On these much discussed methods, then, I fear we cannot go as yet beyond approximate and provisional opinions. That such measures, carefully and timely used, may be very efficacious there can be no doubt, and when useful they are radically useful; but their sphere of usefulness is smaller than is commonly claimed for them.

Nauheim then lies on no royal road to recovery, and it cannot be said that the method is gaining ground among those independent observers whose judgment is most to be trusted. Dr. James Mackenzie has recently submitted the "Nauheim methods" to a critical examination, which, if perhaps erring on the side of severity, was much needed and cannot but be very beneficial. The difficulty in judgment, embarrassing as the intrinsic conditions often are, is intensified by the interference

of many and variable incidental factors, such as the prepossessions of individual physicians, and such as pertain to the repute of particular institutions or health resorts. There is no doubt that the recorded results are largely improved, on the one hand, by the inclusion of trivial or transient cases which could have been treated at least as well elsewhere and without such formidable and costly apparatus, and on the other hand, are enhanced by the exclusion or dismissal of unpromising cases. Eichhorst, whose opportunities in Central Europe for judgment must be considerable, says in the new edition of his handbook that the cases which do well at these spas are those which do well anywhere under equal conditions of systematic and obedient rule; and he gravely deprecates the disturbances of these patients by the trials of a long journey. For my part, I must admit that after a course at Nauheim or some other such resort—a course with baths, exercises, and methodical exertion—the cure seems to be more persistent than after relief by ordinary medicines and regimé at home. This greater stability I attribute to the persevering use of reparative measures, but especially mental tranquillity in fresh air for some time after the urgent symptoms have been relieved. Another impairment of the facts on which our judgment must be based lies in certain fallacies, some obvious, some subtle, some personal, in the methods of physical examination by which a large number of the cases are judged. Again, those means, in the hands of us all, of rest, diet and regimen, removal from home worries, systematic management by trained assistants, and potent medicines, are used dexterously at Nauheim, and, together with the imposing ritual of spa therapeutics, contribute a large and incalculable part of the cure. Still, all deductions made, the methods are interesting, and as we cannot yet obtain the accurate data which a scientific study of these methods requires, data which will no doubt ere long be provided, we must, from the imperfect facts before us and from personal experience, formulate a rule of thumb. Broadly, they are for hearts which had fallen temporarily behindhand, and have a capacity not only for amelioration by liberation of reserve energy but also for substantial recovery by re-creation of cardiac muscle.

The manual gymnastics may be divided into three classes: the passive movements or massage; the free or Oertel exercises; and the resisted exercises. As the distribution of the blood and the velocity of its currents are bettered, and the coronary circulation is restored, partly by higher pressure, partly by oxidation, the mean arterial pressure will rise; and within limits the rise may be taken as a measure of the good done by the gymnastic methods in their various stages. It is very important, then, that the management of the respiration during the exercises should be managed as carefully as the exercises themselves. Haldane's last researches indicate that although at rest pulmonary aëration seems to be a mere diffusion process, yet on exertion some other factor of the alveolar epithelium—probably a quasisecretory virtue—comes in. This function rest scarcely encourages; and under the efforts also the patient is prone to hold his breath, a condition to be

strictly avoided. Deep and equably alternate respiration must be the rule; but if there be any sense of oppression two or three long inspirations should be drawn before the efforts are repeated. Not only do we thus secure the activity of the respiratory pump, but we improve the quality of the blood. Perhaps simultaneous respiration of dilute oxygen might be beneficial. To reinforce the coronary circulation is of little use if the blood be not worth the fetching. Blood which has been lying stagnant in the splanchnic and other great veins, or in the liver, even if it finds a way into its tissues, does not refresh the heart, unless it can be drawn through an airy lung; for within moderate variations of pressure the flow of blood through the coronary circulation, which has little vasomotor governance, is directly as the oxygen used and as the carbonic acid, or correlative metabolites, eliminated. Thus in experiment on animals oxygen reinforces the vigor of the pulse; carbonic acid, on the other hand, reduces the height of the pulsations and ultimately brings about a standstill in diastole.

The graduated exercises of Oertel, after attracting too indiscriminate attention, have now fallen into as much neglect. Herz of Vienna has reorganized the method with some improvements. To Oertel more than to any other physician are we indebted for researches on the theory and practice of "cardiac gymnastics," yet when a new method comes into notice, the public, and even its physicians, are apt to run after it rather blindly; and so, by many an indiscretion, what may be good in a new method is obscured, and the whole of it petulantly repudiated. Now, if Oertel's method be applied to those cases only for which it is proper, and if it be vigilantly watched by the physician in charge, it will prove of great service; but it should be practised with some regard to exertion and rest, even if the alternations cannot be so exactly regulated as in the Schott method. It is perilous to let a patient start off on a walk when on returning he may suddenly find himself exhausted. In cases of intrinsic degeneration of the cardiac muscle it is applicable, if at all, only in early stages, very tentatively, and under incessant medical supervision, and one would say that to disease in the aortic area Oertel's method is scarcely proper. Sir Douglas Powell says that some guide to the use of the method may be found in a walk round the consulting room (see Test Exercises, p. 66); in a patient who promises well, the effort, by promoting completion of the systole, may bring down the rate and increase the energy of the heart beat. Oertel's method, which makes a stronger call upon respiratory activity, is most efficacious in cases of obesity in which intrinsic deterioration of the cardiac muscle is an inconsiderable or subordinate factor, but we must have care lest our fat patient be an arteriosclerotic.

Dr. Babcock emphasizes this need of respiratory development, and he also suggests a modified course of exercise to this end. Still so potent are the effects of fresh air respiration and of general muscular development, that we see with surprise the beneficial effects of outdoor work upon well-fed laborers, how oxydation is the regulator of circulation. Young farm men, gardeners, and the like leave the hospital

after acute hematoma with both heart and constitution seemingly wrecked, with double valvular disease, anemia, and emaciation, and yet in their employment recover health and sufficient activity for many years efficient service. The method is proper, also, for dilatation dependent on high arterial pressure when this pressure has been moderated, to simple atony of the heart, and, above all, to mitral regurgitation of moderate amount in a fairly sound heart. Such patients must creep from degree to degree under the watchful eye of the physician, advancing or retiring as from day to day the reports may indicate. During the exercise the acceleration of the pulse must be noted, and the time noted for the acceleration to subside on sitting down. The exercises should be performed in a fine bracing and rather elevated climate, but not at a height where oxygen would be in defect. The tracks must be easily and accurately graded, and the patient subdued to absolute obedience. James Mackenzie sagaciously advises that the walks be made interesting by some scientific or other diversions. Patients submit to such methods, and to the dietetic and other conditions of them, better in companies, and in the fashion—that is at health resorts—than at home; moreover, the results are the better the more remote the cares and monotonies of ordinary life. It is needless to say that before undertaking this means the patient must be carried as far toward the recovery of equilibrium as ordinary medical means can achieve; and cases of substantial reserve capacity in general health as well as in cardiac quality must be selected. The Oertel method may be called the *pons asinorum* on the way of cure.

Oertel's dietary was rather fanciful; he dwelt too much upon the volume of the blood, which is only one factor of many. These exercises, as I can personally testify, can be carried out efficiently on ordinary rational diets.

For graver cases, but still for cases of substantially the same kind, the "Nauheim" or Swedish exercises are more appropriate. When the patient has been carried as far on the way to restoration as the sparing methods may compass, or is in but an incipient stage of his malady, these exercises, with or without medicinal remedies, may secure and establish the amendment. In the common use of them there is one grave fault; namely, that they are, ordinarily, though not necessarily, carried out indoors; a disadvantageous condition of any muscular exercise. Partly on account of this indoors condition, partly also, because in them the tact of the attendant is less intimate, machine exercises are less trustworthy. The Zander machines, adaptable and most accurately graduated as they are, yet tell no tales; the human agent watches or should watch closely the effect of each action, and of the duration of the sitting upon the patient; and these degrees and durations are continuously and almost insensibly modified according to the perceptions of the performers. The resistance itself is by some suggestiveness to steady the patient's mind, as well as to steady and indeed to support the limbs; thus, when the mind is weary, or (as in children) inattentive, these exercises may be futile, if not harmful.

The special baths are now regarded as an alternative method of compassing the same ends as the gymnastics. In Nauheim itself the proportion of baths to exercises varies a great deal, either with the individual physician or with fluctuations of opinion. In some seasons patients tell us baths were in fashion, in others, exercises. Baths and exercises are not used contemporaneously. The bath may be used in such cases as convalescence from infections, when we may be mistrustful of digitalis. Its virtues are attributed to three qualities; namely, to its temperature, to its saline constituents, and to the carbonic acid disengaged in it, which seems to act on the skin as it does on the coats of the stomach. The tests of benefit are likewise retardation or regulation of the pulse, and a due flow of urine; physical examination of the liver as to size and tenderness, and of the heart itself will also guide the physician. Acceleration of the pulse indicates immediate cessation and rest, and that the bathing has been excessive or ill timed. One day of overtaxation may lose much of the benefit previously obtained; a great deal depends, therefore, upon the tact of the physician and on the conditions of the case. I repeat, that after bath or exercise the patient must observe a long interval of rest, a counsel too often forgotten or disregarded. For example, if there be two exercisings or one bath a day, the patient must be kept at rest during the rest of the twenty-four hours. He must never be allowed to dry himself after the bath. It is obvious that if the bath be at a temperature lower than that habitual on the surface of the body—under about 90° F.—the superficial vessels will contract, with the effect of raising the arterial pressure. Although the skin under the irritation of the salt and gas reddens, the limbs under phothysmographic measurement show no expansion. If the fine vessels expand velocity must be increased. Such an elevation of pressure is by no means certainly mischievous, and may be beneficial; but to force it upon a heart incapable of adequate response would be premature, and probably harmful: we shall be content to hasten slowly. We shall dip the body at first into water within the "indifferent zone" of temperature (95–100° F.) and use the weaker saline (say $\frac{1}{5}$ of the full standard dilution[1]). Within this zone the arterial pressures are raised slightly and transiently, and these and the pulse soon fall to normal, while the velocity is increased. Baths at 104° F. raise the pressures and the pulse rate considerably. Under the stimulation of the skin by the saline and the gas the temperatures may be lowered gradually, even for substantially reinvigorated hearts, to 77° F., and the demands upon the heart thus pushed little by little without discomfort or chill; *pari passu* the contraction volumes, the velocity and arterial pressures are increased, and the respirations are deepened without acceleration. Spa discipline and suggestions apart, these baths can be administered quite well at home. They must obviously never be used

[1] The "ganzes" (strong) Nauheim bath contains 1 kg. bicarbonate of soda to 1¼ kg. commercial muriatic acid to 250 liters of water. I need not occupy valuable space with the method of preparing the baths, as full instructions are given with the materials sold for the purpose. These baths are not to be recommended to persons liable to eczema.

in severe stages of cardiac distress, not, for example, in dropsical cases; and when administered the blood-pressure should be carefully recorded before and after. Two baths a week is enough at first; then watchfully the number may be increased, according to the indications, to three, four, or five a week; and the duration increased from five to twenty minutes. The best hour for the bath is the mid-forenoon; at any rate early in the day, and not near a meal. Some patients, however, before exercises need a little light food to prevent "sinking" sensations. To promote the respiration the airiness of the bath-room is a condition too often forgotten. Dyspnea, palpitation, fatigue, oppression or pain, fall of arterial pressures, or acceleration of the pulse are among the chief contraindications. Physical signs are of less value; many of the patients for whom these methods are proper are obese, and in most the positions of the diaphragm are inconstant.

The graduation of the salinity is more important than the absolute quantities; as with the temperature, so with the saline, we shall begin with a low percentage of saline and gradually strengthen the solution as the heart finds vigor to respond. The same is true in less degree as regards the carbonic acid, though a certain degree of this aëration, by the interposition of non-conducting gas bubbles between the water and the skin, moderates the chill of the cooler temperatures. At Franzensbad the carbonic acid content is regarded, I believe, as more useful than the saline. After the bath there should be no "cooling," and, at any rate at first, no exercise; but quietude, warmth, and mental repose.

In the present empirical state of our knowledge of the subject, which is somewhat of an "impressionist" kind, it would seem, then, that the baths are but a mode of blood compulsion not essentially different from the exercises. "Hydriatic digitalis" Winternitz has called them; but as I have said, they aim a little higher than this. If these methods are to be put upon a scientific basis they must be tested with more precision; with accurate measurements of blood-pressures, urinary estimations, etc. The ordinary physical signs observed from day to day, when taken together with symptoms, serve us well enough as rough and ready guides to practice; but rule of thumb is one thing, scientific demonstration is another; and by very precisely ordered orthodiagraphy only —such as I understand has recently been organized at Nauheim— can the results of these new methods be controlled. Meanwhile we may accept it as probable that the baths and exercises do "pull in" the heart; certainly, in favorable cases, the pulse improves, the liver recedes, the respirations are enlarged, and the heart and circulation are reinforced.

In cases, then, of the class and under the conditions I have indicated, after medicine has done its best for equilibrium of function, the Nauheim methods, and in more vigorous cases, Oertel's, may not infrequently compass and consolidate a cure. For moderate mitral regurgitation, doing well in a person not over middle age and otherwise healthy, the effect of baths and exercises skillfully applied at an appropriate health resort should confirm a substantial amendment for a

period of two to five years; and then by timely return to them, as occasion may indicate, life and fair function may be secured for indefinite periods.

Functional disorders of the heart are perhaps best treated, as a rule, by those ordinary medical means which are usually as efficient, and are less apt to fix morbid ideas in the patient's mind.

Hydrotherapy.—To the good effects of general hydrotherapeutics in the relief of heart diseases we have the strong testimony of Winternitz, testimony to which I am able to give some personal support, though my experience has been fragmentary and much of it at second hand. It is not easy to find elsewhere institutions where "hydropathy" is practised with the science and discrimination of the German methods;[1] yet it is obvious that in cases of this class—unless the cardiac affections be of a very fanciful kind—hydrotherapeutic methods must be conducted with the closest attention to the requirements of the individual case. Concerning the influence on the heart of the cool bath treatment of typhoid fever the reader is referred to Acute Cardiac Disease (p. 23), and the use of special baths in chronic heart disease has just been discussed.

Warm baths, unless for a temporary calmative effect in a few cases, have no great part to play. They conduce, indeed, to lassitude, atony, and dilatation of the cutaneous vessels. Sitz-baths of 85° to 75° F. of brief duration, followed by friction, are much more efficacious. Packs, again, are often useful, especially in moderating frequent pulsation; and these may be alternated with the sitz-baths. If the pack is suitable to the case the pulse rate may be reduced by 10 to 20 beats. Determann has found packs effective for good in cases of Graves' disease which had resisted many other methods of cure. In anemic and atonic cases the douche, tepid at first, then adapted to the resistance of the individual, and used alone or in combination with the sitz-baths, and in either case accompanied with friction to the skin, is employed with success. Every patient should be warm on entering the bath, and those who are equal to it should take a brisk little walk afterward.

For irritable palpitating hearts cold packing upon the cardiac area will prove more soothing and tolerable than an ice-bag; the compress may remain in place for half an hour to an hour. To feebler persons, and in cases of lagging heart's action, hot local packings are more beneficial. Various combinations and distributions of these methods are suggested by the various morbid dispositions, vascular and other, of the individual. The duration of a water-cure is from five to six weeks. It must be remembered that a fine air, careful régimen, and relief from customary engagements and vexations count for a great deal in a successful result. Speaking generally, hydrotherapy is more effectual in functional cardiac disorders.

Massage.—We have seen that the rule is not to submit to the baths and exercises a patient who is ill, one in whom the circulation is dis-

[1] Winternitz, Hydrotherapie, Wien., 1890, and Determann, Volkmann's Sammlung klin. Vorträge, 1894.

ordered and the blood badly distributed. A few passive movements may, indeed, be attempted cautiously, even on the bedridden, after rest and medicines have done something to clear the way; but for enfeebled or much embarrassed organs even massage, unless very carefully initiated, may prove too trying. Moreover, soon after acute rheumatism it may recall the arthritic pains. Massage, if only for twenty to forty minutes, is a severer trial than is generally supposed; it must be begun in short periods—periods of a few minutes—and confined at first to the legs. On days of massage the patient, unless well on the way to convalescence, must be kept otherwise absolutely at rest. The method may then be extended gradually to other parts of the body, by no means omitting the abdomen; every care being used to keep well within the capacities of the patient, and to leave him at rest in the intervals. Besides their mechanical effects the manipulations and baths seem to have some obscure regenerative influence through the whole nervous system; referred impressions may be the centripetal converse of "referred sensations." In typhoid fever the effects of the bath are quite as notable in the nervous refreshment as in the reduction of the fever. Again, the uses of massage are not only to promote the circulation in the splanchnic and peripheral blood-vessels, and thus to reduce the distal resistance to its flow, but also to promote or accelerate the flow in the swollen lymph channels; it is desirable, therefore, to make pressures, for the most part, upward. Even in old and brawny anasarca skilful and patient massage may have a striking effect for good. One of the worst cases of brawny anasarca with orthopnea I ever saw was dissipated, slowly but in the course of a few weeks, with astonishing success by the devotion of a member of the family who practised massage, chiefly with the finger-tips and ulnar edge of the hand, assiduously and skilfully to the legs and loins. We cannot always command such help as this, but by the wealthier classes assistance of a more or less efficient kind may usually be obtained. On the other hand, not every massor who offers himself is efficient, and many, by their chafings and poundings, do more harm than good; although in cardiac cases highly skilled massage is not essential, yet it requires careful teaching, skill, intelligence, and a certain tact and nicety of temperament, without which the performance is mere "vamping."

Massage of the cardiac area is highly esteemed by some physicians of authority; but here, again, we need more precise records. Gentle pressures, at first for five or ten minutes, may be gradually increased to somewhat stronger vibratory manipulations and tapotement around and above the heart, and the sittings may be carefully prolonged. The favorable signs are a fall in pulse rate and better output. They are said to have a soothing effect even upon a throbbing heart. In feeble action of the heart stimulation by such a method seems not unlikely to be beneficial, and, as if by reflex stimulation (cf. Abram's reflexes), weak, irregular pulsations are said thus to be invigorated. For throbbing hearts the gentler, for feeble hearts the more energetic, manipulations

are indicated. But in all cases it would seem judicious to forbear from very prolonged or vigorous applications.

Intestinal massage is very important; we all know how cardiac symptoms are aggravated by sluggish abdominal viscera and hampered diaphragm. Special attention should be given to light kneading in the course of the colon, especially about the cecum and sigmoid. Congested viscera (such as the liver) must, of course, be very gently handled, usually by vibration or light tapotement only. Furthermore, by careful manipulation much may be done to bring down the diaphragm and to reanimate the respiratory pump.

The attacks of tachycardia may, it is said, be mitigated or stopped by massage, abdominal compression, and respiratory gymnastics.

After an initial period of massage, the patient may be encouraged to undertake certain spontaneous movements on his own part, such as the flexion and extension of a wrist, forearm, ankle, or leg. Movements of the arm, especially when above the heart level, are more trying than those of the leg; so that leg movements should be tried first. Movements of adduction and abduction will follow, and so on until, as progress is made, these movements may be "resisted." Thus, in order to regulate the movements as the capacity of the patient is increased, an improved circulation in the vast muscular areas, of which the healthiest of us find the inestimable benefit, may be attained. If by initial massage the muscular circulation can be developed, the heart and the great internal veins will be enabled to get forward the sluggish currents of accumulated blood; for by exercises, active and passive, the blood courses of the muscular area may be even trebled.[1]

The heroic assaults upon a faltering heart by way of abdominal section and rhythmic bimanual squeezing of it through the diaphragm and the left wall of the thorax seem by no means to have failed utterly. In a moribund patient such desperate remedies may have their justification in occasional successes, as in the remarkable case published in the Intercolonial Medical Journal of Australia by Dr. Ramsay.[2] About ten such successes are on record. The difficulty is to decide upon the moment of its performance. It may be successful up to five minutes after cardiac failure. Artificial respiration should follow the operation.

Nursing and Management.—Some of the reflexions which come under this head address themselves to the physician, some to the nurse; it is not worth while to distinguish them carefully; nor can we always stop to distinguish between the comforts of the hospital and the luxuries or refinements of the wealthy. When we ask a student how he would treat this case or that, his answer too readily begins, "I would put him to bed at once," etc.: now, this may be an idle or a bad beginning. Nurses are often far too fussy in hustling a patient at once into bed on his arrival in the ward; the poor man is often out of breath, and has

[1] Full descriptions of all these methods are to be found in the chapters by Dr. McKenzie in Volume I of this work.

[2] Quoted in the Lancet, Nov. 17, 1906. See also the article in the Lancet, Dec. 22, 1906, by Dr. Green, of Bristol, England, with a summary of all published cases; and Brit. Med. Jour., Nov., 1909.

not taken in the situation; he is, perhaps, chilly and perturbed and not at the moment apt to take orders. Let him sit a while by the fire, where he will get warm and less uncomfortable, and a kindly word or two of peace will tranquillize him, until he is himself disposed to prepare for bed.

The bed must, of course, be a "single one"; woven wire mattresses for single beds are good, but are apt to be cold underneath: the wire should, threrefore, be stretched upon a wooden frame 4 inches deep and underdrawn with thick canvas; so that a layer of warm air is maintained under the wire. Or some thickness of blanket may be laid upon it. The French box mattresses, containing spiral springs, are the best for private houses; for a heavy patient sitting up for breath the wire woven mattresses have scarcely enough resistance, unless drawn very tight, when they become too hard. If a French mattress is not to be had, a good, thick horsehair mattress is better for such persons.

The bedroom should be on the ground-floor; an upstairs chamber prevents many a little walk or drive at the beginning of convalescence. It should face south in winter, north in summer. It must have a steady chimney, and the nurse must take care to maintain the fire uniformly; not to have a furnace at one time, cold ashes at another. This precaution applies especially to the night; when the fire is "made up for the night" the chamber may at first be too warm, but later may fall heavily in temperature. Patients with heart disease, especially if attended with pulmonary embarrassment, become very cold, especially in the limbs, without being fully aware of it; so that although the window should be opened at convenient times when the patient is sheltered from draught, at night or in ungenial weather fresh air is better obtained by open windows in neighboring rooms or passages. There must be no bigotry about the open window; in cold weather the fire will secure fair ventilation. In those institutions where warmth is obtained by heating the air itself, heart and lung patients will never be comfortable in this respect, whatever the arrangements. Radiant heat from an open fire, with cool air to breathe, is the only means of warming a sick room healthfully.

In private houses the strong bracket with rope and crosspiece, provided in hospitals for patients to lift themselves by their arms, must be fixed, either as a standard or from the wall. Few bed-heads are strong enough to support the weight. One great trial to patients short of breath is the slipping from the sitting position down in the bed; this, and the tendency to soreness of the coccyx from long sitting, are among our chief difficulties in nursing heart cases. It is, therefore, of the utmost importance to anticipate the soreness of the seat from the beginning; so distributing the pressure with air-cushions, pads, and the like that this pain may be prevented if possible. It is of no use to argue with such patients that they must lie down, they know better: they will, indeed, insist on getting out of bed to hang down the legs, dropsy or no dropsy, and it is sheer tyranny to prevent them. The gravitation of the viscera from the diaphragm and of the blood in

the abdomen gives a relief which, at any cost, is imperative. Still as long as bed is tolerable the patient must be dissuaded from getting up; and, to support the body from slip, a roll like the old-fashioned bolster sofa-cushion, but not quite so thick, must be put under the knees and secured at each end to the head of the bed. Bed-rests are tiresome things; I think I have never seen one which contented the patient for long; they seem to be too uncompromising for the many little changes of position, and they never fit the back comfortably. Much better ones might be designed. Many pillows, packed round some central mass, such as a box, or two or three hard footstools, which can be continually adapted to the patient in his restlessness, make up our little best in this way. A strong fulcrum should be provided for the feet also, for which another suitable box, not padded too softly, will answer fairly well. If the patient must get out of bed, get him an arm-chair so shaped that he may have a good grip to fix his accessory respiratory muscles. So long as possible we must persuade him to keep his feet up on a stool; but in severe dyspnea he will have to drop them down, and to rest his elbows on a little stand. His legs will swell sadly, but we must hasten by medicinal means to make this stage of storm as brief as possible.

Breathlessness being so chief a cause of unrest, we must save the patient all exertion; and the same precautionary cares are needed as in acute cases. The clothing, therefore, must be loose and easy, all gowns and petticoats must open handily in front. The patient will see that all belts, collars, and corsets are discarded. To allow free play to the chest, jackets must be very light, but no less warm, as the clothing will often be thrown off. Shetland knitted shawls and vests are very cozy. Fur-lined wool or surgical wool make good protectors. A very odd controversy has recently sprung up in the journals—one party maintaining that in perspiration woolen clothing is bad because it is not "absorbent"; the other party making labored attempts to prove that wool is absorbent; or, if not, that it ought to be. Wool and fur are neither absorbent nor ought they to be; their virtue depends on their preserving a relatively immovable layer of warm air next the skin, a layer not to be displaced by absorption of water, the evaporation of which, moreover, produces rapid chilling. The moisture within is kept comparatively warm between the skin and the clothing, and so evaporates insensibly; if profuse, it must be wiped away with a warmed silk handkerchief.

Few nurses remember how important it is that the little meals should be small in quantity, hot, and daintily served; even hospital patients find such attentions to promote appetite and digestion. Unless sleep be much in arrear it is better not to sleep after a meal; all functions droop during sleep. Patients who are very ill, or who are ordered to be kept absolutely at rest, must be fed; but if the spoon is not put deftly into the mouth the patient is worse teased than if he were feeding himself. All such patients, unless elderly men with large prostates, must be persuaded to pass water into the bedpan, which must be warmed, and for the stools contain a deodorant. If an easy stool has not been

secured by a laxative, an enema may be required, for there must be no straining. The actions of the bowels, the measurements of the urine—to be as full as they can be made by soliciting micturition before the stool—the times and contents of the meals, the snatches of sleep, cough, pain, delirium, etc., must all be scrupulously noted; and the physician who forgets to inspect the nurse's diary, the urine, motions, sputum, etc., loses his hold on the nursing. An experienced nurse learns that she has to deal with different patients in different ways, but in all with tact and sympathy. The gentlest patient shrinks from a tyrannical nurse, if he does not openly resent her ways; on the other hand, the most wilful patient may be tamed by good temper and the velvet glove. At times, to avoid disaffection, it is better for the nurse to give way, even in a matter of importance, and to report the matter casually to the physician on his next visit, in the presence of the patient. After all, the patient—if he be not a child—is his own master. Whether child or adult, these heart patients are fretted by incessant strife for breath, and by want of refreshing sleep; and the nurse will not forget this excuse for many a whim. In most cases to drop the subject for a few minutes, or to make some little diversion, will succeed in turning the awkward corner. The family, too, must remember that if there is to be good nursing the nurse must not herself be tired; the most angelic nurse may be snappish when weary, and what is worse will slacken in those minor attentions which go for much in alleviating illness. A little gentle stroking at the right moment for sleep, when the dread of night is coming on, a few minutes reading aloud, a little eau de cologne on the forehead, a clean pocket handkerchief, a cordial, such as tinctures of valerian and chloroform left to her use, a shaken up pillow, a warm epithem to the chest, a gentle voice—all these things if well timed are as precious as they are fretting if offered fussily.

It is easier for the nurse, who has nothing to do with prognosis, to preserve a cheerful and hopeful demeanor even to the end. For the physician it is not easy, at any rate with certain patients who put questions so searching that it seems impossible to avoid some truth in the answer, and yet who may despair when the truth is before them. The downhearted patient, the patient who does not want to know the truth, the vacillating patient, the hipped and fretful, all these we know, and can comfort; but the patient positive in manner, exacting in questions, yet inwardly unable to bear any great part of the truth, is hard to deal with. Nevertheless, it is in heart diseases above all that these considerations intimately concern us. If the heart be not the seat of the emotions it is a main condition of them. Hope or despair may hang upon the arterial pressures. When these are low, and the spirits flagging with them, the nurse must be careful not by look or gesture to suggest apprehension, even unwittingly. She will avoid every appearance of secrets and oracular sentences; or again, the telling of tales of sick rooms and the like. "Please nurse me slowly" was the pathetic appeal of such a patient; but he did not mean with a labored slowness, with suppressed talk, long-drawn-out shutting of doors and meticulous coaling of the

fire and the like; but with gentle, adroit ways, deft movements, and a frank conversation.

The physician will often have a difficult task to decide upon the advice to give the young convalescent from acute cardiac disease; how to re-educate his heart and to send him into healthful occupation without stresses of a kind to hurt him; or, again, how to permit an older person, maimed by chronic cardiac disease, to return to his employment, or to advise him to change it for another. Advice as to marriage also is, in many cases, a very difficult problem; to frighten a young woman's guardians out of an engagement with a man who has—let us say—a mitral or an aortic direct murmur, or even a moderate aortic regurgitation, or to encourage a man to marry a girl with such a defect, however free she may be from symptoms, is a responsible business. Much must depend on the degree of the lesion and the general state of the patient's personal and inherited constitution, and pecuniary means. If when the truth is fully explained to the friends of both sides, and they decide, nevertheless, to take the risk, the therapeutic value of a favorable decision may be considerable. The affectionate regular life is favorable; in a man the additional peril is that of coitus; of the woman, pregnancy. As therapeutists we are bound to warn an elderly man with arteriosclerosis against coitus, even if already married; and, indeed, the same warning must be given to any patient in whom dissolution of the cardiac muscle is suspected. Mitral stenosis, I think, should always be a bar to marriage, especially in a woman. Although it may not be true that in pregnancy arterial pressures are raised, nor the heart hypertrophied, yet it is the common opinion of all experienced physicians that pregnancy has a detrimental effect upon heart disease. In mitral disease the bulk of the blood may be increased, and the work of the organ thus increased also.

Prevention.—Elderly men of sedentary life, who let themselves drop out of exercise, are liable to a slow enervation of the heart, as of other muscles, which may not reveal itself till late in life and then often more or less abruptly. It is surprising to see the indolence with which middle aged men let themselves slip into muscular inertness. They shirk stooping, they sit to put on trousers, socks, and shoes, and hoist themselves slowly out of easy chairs; they send some minister or other for everything they want, they give up carrying bags or large parcels, and take a cab for every errand. This muscular sluggishness must and does result in impairment of one of the most important and capacious of the areas of circulation and oxidation in the body. Now, an old man, if he will resent this growing indolence, can keep his fat down and his muscles firm and lively. In town life, if it must be sedentary, a preventive practice of baths and exercises may be instituted.

As for the persons we are considering life is generally easy, it is a good practice, if other engagements permit, for elderly men disposed to vascular deterioration, or for younger men who are fat and whose hearts are relatively weak, after a light breakfast before rising,

say at half-past seven o'clock, to take at half-past eight a bath moderately saline and with so much carbonic acid in it as, at a temperature of 70° to 80° F. or lower, may feel pleasant, and as the reactions of the individual in the first few minutes may dictate. Powders for such baths are to be purchased. After the bath, in a fairly warm room, let him, with his own hands, carry out systematic frictions with a soft but rough long towel; friction is made on the trunk by the usual to and fro movements of the towel, and on the limbs by regular compressive manipulations. These rubbings are to be followed by some light exercises also systematically performed, such as dumb-bells of not more than one or two pounds' weight for the arms, and some leg exercises; these should last for about a quarter of an hour, more or less, as the patient's endurance may dictate. Many old persons at my suggestion, have carried out for years sundry light exercises and frictions in a leisurely way for as much as an hour in the morning, resting in an arm chair from time to time, with the greatest advantage to health and activity and renewed resistance to chills and other adversities. Of course the movements must be deliberately performed and varied, and very gradually increased as the muscles are trained. It is well to begin without clubs or dumb-bells, by slow flexions and extensions of the limbs, and the practice of swinging and balancing the trunk of the body. After courses of "Nauheim treatment," again, convalescents should keep up such practices as these, and in the light of their technical experience, should be able to regulate them wisely; always keeping well within their strength, and noting any degree of fatigue afterwards. The dietetic conditions which should be observed, in principle or in closer details, are to be found below. As in the sanatorium for the consumptive, the educative service of a course of spa treatment is no small part of its usefulness.

Diet.—For many years I have urged the importance in the treatment of heart diseases, as in that of phthisis and other infections, of systematic vigilance over the condition of the stomach; and Sir William Broadbent has been no less insistent on this point of treatment. Now, as Dr. Mitchell Bruce says well, that "if the physician does not direct the diet, some one else will," and as in phthisis so in diseases of the heart the stomach is generally reduced in tone, and very often is in considerable disorder, gastric turbulence may not only contribute to the continual discomfort and illness of the patient, but may, indeed, by some unlucky commotion determine a fatal issue. Ill-aërated blood does not satisfy the needs of the organ; its secretions become defective, and the nutrition of its muscular coat reduced in value; an unhealthy, inferior mucus then exudes from its surface, and fermentation with evolution of gases is promoted. If we map out the stomach we shall be surprised to find how widely its cardiac portion, which chiefly affects the heart, may be distended, the walls being weak and the contents windy; the area of gastric resonance may rise halfway up the left chest and pass laterally from the right of the middle line to the middle or even posterior axillary line on the left. In this complication there is something more inti-

mate than the mechanical disadvantage, perilous as this may be. Every student of heart disease knows how doggedly these patients declare that "if they could but get rid of the wind" they would soon find relief of their cardiac sufferings. Not only are the organs contiguous, but the common elements of innervation in them may also have much to do with their sympathy; they seem to react mutually, so that the fretfulness of the one is felt in the other. It is said that deficient absorption of wind plays as important a part in its accumulation in the alimentary canal as excessive generation of it; and that under the use of digitalis its absorption is often plainly to be witnessed. For my own part it has been for many years a leading rule of practice to put the stomach right as soon and as far as possible, as in this resource one of the most promising means of relieving cardiopulmonary distress is to be found.

Not rarely it is necessary to begin by reducing the nips of alcohol in which such patients have, not unnaturally, indulged when they felt faint, which was only too frequently; so that the total sum of these nips often proves to be far more than physician, patient, or friends had supposed. If then by etheral cordials, or a little champagne which has stood a few minutes to allow its effervescence to subside, the brandy is gotten rid of altogether, we can proceed to reduce the bulky carbohydrate food, especially in the form of pulpy farinaceous puddings, vegetables, raw fruit, and the like, which, by both bulk and the generation of carbonic acid, contributes to the distention of the stomach, while at the same time, during the enforced muscular inaction, combustion and exhalation are retarded, and oxygen is consumed which can be ill-spared. In the ferment of catarrh of the stomach carbohydrates are particularly ill digested. A vegetarian diet needs the nicest of cookery. Fish, broiled or boiled, panada or rissole of tender meat, a little sieved vegetable, raw meat sandwiches, jellies, junket, blancmange, light custards and cup puddings sweetened with saccharine or actose, certain patent foods, peptonized milk, a baked apple or a few grapes, and the like are to be preferred. Thin crisp toast, biscuits, and rusks are more suitable than bread. The profusion of milk in heart disease has been dictated by physicians who are in dread of the "toxins" of an animal diet. In some cases, as in those of persons of gouty habit, this precaution is no doubt of importance, but in my experience a diet of tender meats is the more suitable for most cases of heart disease, and even if the kidneys are in no safe condition I am not easily deterred from it. But even then, as also for those who are of a gouty or plethoric disposition, a diet low in purins yet without excess of carbohydrates presents no difficulty; and, on the principles explained by Dr. Walker Hall, can be devised with a pleasant variety.[1] Bacon, tongue, and other salted meats will be admitted sparingly, if at all. It is said that more of a mixed diet can be digested if the nitrogenous and carbohydrate foods are given at different times. Butter and cream in moderation are digestible, more so than fried meats and rich sauces; but the butter sold as fresh and pure is usually very far from being either, and by

[1] The Purin Bodies of Food-stuffs, second edition, 1903.

the queasy stomach the impurity is resented at once. The finest butter must be procured both for table and kitchen, whatever the price may be. If fish is to be fried, it must be in pure salad oil. In obese patients, however, a fattening diet must be avoided. At the meals the fluids are to be reduced as much as possible. After a little perseverance the patient will be able to content himself with a wineglassful of water at dinner. Milk is often given in excess, even by medical urgency; as are dilute soups, slops, and aërated waters. A coffee-cupful of good sapid beef-tea, however, taken a few minutes before the meal, often rouses appetite and forwards the secretion of gastric juice. In some persons a little good calf's foot jelly has the same effect. Starches and sugar seem to have no such gastric stimulation (Pawlow). To secure fair nights and safe nights watchfulness in diet is especially needed of an evening; the dinner ought to be at midday, and the supper almost nominal. Death, as Sir William Broadbent says, may lie in an erring supper. After every meal a period of rest must be strictly enjoined. Attacks of flatulence may be palliated by oil of cajuput, of peppermint (or menthol), of cloves, or by spirit of chloroform, separately or in combination. More systematically, a cachet of benzonaphtol, or a mixture of bismuth, sulphocarbolate of soda, and chloroform may prove useful. The essences may be administered as drops on a little bread or sugar, or as an emulsion in a bitter infusion. Even the compound galbanum or asafetida pill is welcome to some of these wind-bound patients. Gentle massage of the belly is grateful, and forwards the expulsion of wind. A long flexible tube passed up the rectum and left there will often carry off wind from the colon; and I am told that in case of urgent need intubation has proved itself very efficacious in obtaining a like relief from the stomach. James Mackenzie declares that in cardiac discomfort, with its forced breathing and deglutitions, much air is swallowed. Both physician and patient must be on guard in this matter.

On the empty stomach the patient may drink such fluid as he really wants; but the habit of drinking more than the body needs is as soon broken as it is soon acquired. Indeed, when alcohol has been withdrawn for a while the craving for fluids usually diminishes. As we have argued elsewhere, in no form of cardiac disease is it well to load the vessels with fluids beyond the strict requirements of the system. Even in the healthiest person fluid intake and diuresis do not run parallel, nor nearly so; and where circulation and kidneys are disorded diuresis often lags far behind. I have never had to take to rectal feeding in these cases, but more than once have had recourse to the well-known "Salisbury method," and with much advantage. This diet is, I presume, unsuitable if the kidneys be diseased.

Finally, diet must be adapted not only to the disease and stage of treatment, but also to the individual. Consider his fancies, for a dull diet does not attract the digestive juices. For persons intolerant of tea and coffee, well-prepared cocoa from the nibs must be prescribed. For many individual peculiarities no general rules can be formulated for the

several kinds of cardiac disease; but differences of diet may be suggested by the ingenuity of the physician. For example, the dietetic rules for dilatation under high arterial pressure, for cardiac atrophy, and for functional heart affections, must be widely different. No change of dietetic system, however desirable, should be made suddenly. The meals should be smaller and more frequent than in health.

Climate.—In one way, at any rate, diaphoresis is happily applied as a remedy in cardiac disease, namely, by the assuasive influence of a warm, equable, and dry climate. We learn from our brethren in Scandinavia, Russia, and Switzerland that heart diseases do badly in cold climates, not merely, but in part, because of the closure of the skin. In the Riviera, on the other hand, in the Canaries, or in Egypt heart diseases do well, and chiefly because of the continual diversion of the blood through the reservoirs of the superficial parts of the body. In congenital heart disease this amelioration in a balmy climate is very instructive. A patient with heart disease often fails to respond to treatment until we can send him for three or four of the winter months to such a health resort. For the same reason cooling airs, so restorative in phthisis and many other maladies, may, by constricting the cutaneous vessels over long periods of time, embarrass the heart. Much depends on the stage and kind of disease, but as we have seen there must not be too much zeal in the ventilation. The patient's chamber should be roomy and in its aspect pleasant and sunny, but not draughty. The seaside, *i. e.*, within a mile of the strand, except in certain winter resorts, is not always suitable; patients say their "livers get wrong" or they do not sleep well. It is agreed on all hands that, whatever the climate, highlands—say, over 3000 feet of altitude—are, climbing apart, injurious as a rule in heart disease. But hill climates below this elevation often prove very beneficial, even while all other therapeutic influences except, of course, rest and peace are suspended. Dr. Haggard says that in the rarefied air of the mountains mitral disease does badly, but in aortic disease mountain air is well borne and the tonic effect often beneficial. The air is more exhilarating, digestion improves, the heart is better nourished, and perhaps the increase of the red blood-corpuscles is favorable to cardiac nutrition. Cases in which the circulatory perturbations are dependent on "cortical causes"—on nervous fag, on vasomotor caprices, etc., are especially amenable to the influence of moderate altitudes—say of 1000 to 2000 feet. The Californian health resorts in America are excellent for heart cases. In Europe, Montreux, Meran in the Tyrol, by moderate elevation, shelter from winds, mild and sunny seasons, and beauty of scenery, are typical health resorts for these cases. Even in healthy persons the capacity for muscular exertion and the absence of fatigue at high altitudes is as remarkable as it is as yet inexplicable. Lake Garda and Palermo may also be specially mentioned.

FUNCTIONAL DISEASES OF THE HEART

This is not the place to justify so equivocal a term, but to accept for convenience sake a term which is generally intelligible—perhaps so far defensible. Happily, the nerves play a far smaller or a safer part in survival than the muscles of the heart. However, not infrequently functional irritation is superadded to organic disease, when relief, if it be only of the former part of the suffering, may be a great comfort and aid. For treatment it is important to divide the functional disorders into those which apparently arise in some part of the cardiac nervomuscular machinery, from those which seem rather to be but items in a general disturbance having its main origin elsewhere. Such a division, in respect of treatment, is radical. To these two classes one more may be added, if but to be dismissed; namely, the frequent cases in which a patient will complain, or at any rate assert the existence, of cardiac disease or disorder when none such can by any vigilance be detected by the physician. Such cases, even if there be some sensation in the cardiac area to attract the attention, fall under the head of hypochondriasis, and are not within the borders of this article. Nor can we tarry to consider at any length the disorders of the second class; namely, those in which the heart plays but a sympathetic part: for the cure of these influences depends upon treatment of the general condition, or of a disorder of some organ other than the heart. The physician will, therefore, closely inquire into all possible peripheral causes, such as visceroptosis, uterine disorder, and so forth.

In doubtful cases in middle-aged persons one test is to irritate the trigeminal nerve—*e. g.*, by strong smelling salts—which slows the normally steady heart but accelerates the "neurotic heart"; thus a diagnostic hint for treatment may be obtained.

Yet even, if we conceive that in particular cases the heart is set wrong by some eccentric influence, in some of these the cardiac storm is so predominant and oppressive above the other features of the case, especially for the patient, that some medication, at any rate of a palliative kind, must be directed to the immediate relief of the heart, even if its complete restoration cannot be compassed until the whole patient is altered for the better. The following may be given:

℞. Sodii bromidi..... gr. x;
Tincturæ digitalis..... ♏v;
Syrupi limonis..... ♏xv;
Infusi cascarillæ.....ad. ℥j.—M
(For irritable states of cardiac disease.)

℞. Tincturæ ammonii valerianatis..... ℥j;
Spiritus ætheris compositi..... ♏xv;
Tincturæ quininæ compositæ ..... ♏xxx;
Aquæ menthæ piperitæ.....ad. ℥j.—M.
S. Every three or four hours.

In some cases of neurasthenia, for instance, cardiac symptoms may be so eminent and vexatious, sometimes, indeed, so agonizing,

as to tempt us into incautious and superficial analogies with angina pectoris; in such cases to wait philosophically for indirect relief by the regeneration of the whole body would be to forget no little of our duty as physicians. At the same time we shall assure the sufferer that only by such a complete restoration can a radical cure of the disorder be brought about, and thus strengthen his will by leading him to look beyond the instant distress to the goal of more intimate and general recovery; a goal not to be reached by temporizing with palliatives only. To soothe the heart by this sedative or by that—by bromids, belladonna, digitalis (as follows), and the rest—without undertaking with still more seriousness the substantial cure of the whole man, is to lie in the pit.

℞. Tincturæ belladonnæ..... ♏v;
Tincturæ digitalis..... ♏v;
Aquæ laurocerasi..... ℥j.—M.
S. Three or four times daily. (For irritable phases of cardiac disease.)

We must remember that even in organic diseases of the heart there is often a considerable fringe of "functional disturbance," especially in overstrung, irritable, or depressed persons, to whom peace, hope, and change of scene are restorative.

For the proper initiation and pursuit of such measures, however, the reader is referred to the sections of this work on Neurasthenia, Graves' Disease, Chlorosis, etc.

To turn, then, to the cases in which, not being deteriorated by some quality of the blood, as in chlorosis or Graves' disease, when special remedies are indicated throughout, the heart is affected by some nervous change of its own, as in neurasthenia, tobacco- or tea-poisoning; or, again, suffers in individual cases predominantly, as in certain "gouty" or dyspeptic persons in whom the accompanying disorders, if perhaps more fundamental, are less obtrusive than the secondary cardiac; how shall we soothe the heart on the way?

The principal maladies in which we have to do with rapid but regular action of the heart are two; namely, Graves' disease and paroxysmal tachycardia. In more cases than is generally supposed Graves' disease exists in a covert form, a form without the exophthalmos or the goiter by which, in ordinary instances, it is betrayed. To one who is forewarned, however, the diagnosis should not be difficult, as fine tremor, heats, attacks of diarrhea, changes of temper, together with the cardiac state, ought generally to suffice to indicate the nature of the affection. The diagnosis made, the treatment is also determined, and in this work is to be found under its proper head. In convalesence tonics are suitable.

Paroxysmal tachycardia, however, so far as treatment is concerned, must be dealt with here; unfortunately, in the present state of our knowledge a very brief and shallow paragraph it must be. A good many of these cases have fallen under my observation, and although I have to submit to the general opinion of their inveteracy, yet in a few I have seen amendment and even permanent cure. A fat man, about

fifty-five years of age, moderate in wine, but of robust appetite for food, of impulsive temper, and exposed to many trials of fortune, consulted me for cardiac disorder. As I was not able, on an occasion or two, to find anything wrong with the heart, I assumed too readily that he was suffering from some intermittent dyspeptic or gouty perturbations. It happened, however, that one day he had an attack in my room, when its nature, as paroxysmal tachycardia, was revealed. The malady had been at work for some months, perhaps for a year; it was not, therefore, inveterate, yet the attacks were by no means infrequent in recurrence. I cut down—carefully and gradually, indeed, but decisively—the amount of food, and reduced him in weight by some two stones. The stresses of business were averted and many little rules and precautions were laid down, such as exclusion of tea and tobacco, which, however essential in the individual case, cannot be detailed here. Under this régimen the attacks became fewer and fewer, so that a sea voyage could be safely recommended. To cut a long story short, for long it was, the attacks grew less and more and more separate in time; and now for at least a year they have virtually disappeared. I cannot say that any drugs proved to have any specific value. In another case in a woman of restless and ardent temperament a cure was ultimately achieved by strict rule of life, a course of rest and massage, and the use of Nativelle's granules of digitalin, which in her case proved efficacious.

During the paroxysm, if certain postures are without effect, little can be done to relieve the sufferer. The postural remedy seems to vary with different patients; but all seem to consist in an elevation of vascular pressures, arterial or venous, or both, either arresting a ventricular rhythm or arousing the vagus by carbonizing the medulla. A 2 or 3 per cent. inhalation of carbon dioxid might indeed be tried in tachycardia. One patient will force his body down between his knees, squatting, and clasping his ankles with his arms; another stretches out his body on the bed, and, anchoring himself by the upper bed-rail, throws all his muscles into urgent contraction; another simply holds his breath to the utmost, etc., each discovering for himself an attitude efficient in his own case. Compression of the splanchnic area so as to force the blood into the heart is said to be effective in some cases. Unfortunately, by no means every sufferer succeeds in finding a gymnastic effective for his purpose, and there is no alternative but to bide it out for a period, in some bad cases, not bounded by the twenty-four hours. Antispasmodics, such as ether, valerian, the bromids, etc., are the least ineffectual; but no special potency can be credited to them. In the lady mentioned above, it is true, the use of Nativelle's digitalin granules aided in her cure, though digitalis in its galenic forms had seemed to fail. Another of my patients found relief in a mixture of salicylate and bromid of sodium. At certain spas iced water compresses are said to be effectual both for relief and cure: they are applied over the heart; 30 gr. of quinin, given in divided doses within two hours as the attack approaches, is said to have been successful. I repeat, however, that in most cases all that can be done is

to rectify, nourish, and invigorate the system, as far as possible; and to promote regularity and amenity of life. In thin and worn persons rest and massage will take a leading place in the cure; in persons of plethoric habit the principle means will be dietetic and defecative. Such methods find their description on other pages. Baccelli seems to have had no little success in extreme cases with the intravenous injection of strophanthus. We have seen that so extreme a resource must be reserved for the gravest cases of heart failure (p. 80).

Irritable Heart.—Quite different in nature and in prognosis are the irritable hearts of certain "neurotics," in whom some cardiac disorder at any rate is persistent, although at times it may culminate in occasional storms so violent as to suggest paroxysmal tachycardia. But it must be remembered that paroxysmal tachycardia is a somewhat rare disease, while "palpitations" are common. In this kind of disturbance the heart scarcely ever settles down into perfect quietude; in tachycardia the heart is generally normal between the seizures; the storms of palpitation nearly always admit of some amelioration, those of tachycardia, as we have seen, are too often inexorable. In palpitation, the thump of the heart is often violent, so violent that one wonders whence comes such vehemence in a weakly woman; in tachycardia, so long as the heart is sound, the beats, rapid as they are, generally preserve a regular rhythm and the thump is not usually exaggerated. Aconite is seldom a proper cardiac remedy, but, used with caution, it will calm a throbbing heart when other remedies fail, and this without ulterior harm. A drop of the tincture may be administered, and repeated every fifteen minutes for three or four doses. The drug should not be left to the management of unskilled persons, nor should its use be continuous; it is but a temporary palliative in distress. Simpler means are usually sufficient, such as cold or very hot epithems—as the patient's sensations may dictate; with diffusible "stimulants," including valerian or camphor, the open window, and the like. All that is now wanted is to ride the storm, encouraging the patient meanwhile; and then during comparative calm to bring about that radical cure which rarely presents insuperable difficulties. Rest, isolation, the enrichment or restriction of food, and, especially, attention to the digestion and bowels, and exclusion of alcohol or tea or tobacco; control of the wilful patient, or reassurance of the timid, and protection of the worried or overwrought, are means of general application. More specific means are digitalis—a drug not often, indeed, necessary nor very effectual in these cases—cactus, adonidin in quick low-pressure action, convallaria perhaps, prunus virginiana, monobromid of camphor, the valerian bodies, the bromids, and so on.

On the whole, of these specific remedies I have found cactus ("cactina") the best; belladonna, caffein, and strychnin are usually inappropriate, morphin always; but if sleep be capricious its place may be supplied occasionally by veronal or chloralamid. For the same reason a half tumbler of hot water at bedtime may well substitute itself for tea or coffee; though for some persons tea, in moderation, acts as a harmless seda-

tive. Above all things the state of the stomach must be sedulously attended to; harmless remedies such as bismuth, alkalies, and light bitters may be given "on the chance," and tobacco and alcohol must, as a rule, be strictly forbidden. Plasters, as of belladonna, menthol, or opium, when applied over the heart, often give relief by centripetal nervous influence, warmth, support, or suggestion. As palpitation is often set up by some eccentric cause, such as shifting kidney, pelvic disease, or a tiny umbilical hernia, or comes on under loss of blood by piles, menorrhagia, etc., no pains must be spared to press all our inquiries to the bottom, and to remove any such contingent evil even, if necessary, by operative means.

The "irritable heart" of nervous persons, a frequent misery of young adults, is to be combated also by a wise appreciation of the conditions peculiar to the sufferer, by "suggestive" reassurances, and the treatment of all contributory ailments. Of course, we are often defeated in these cases by the adverse influence of some real or imaginary vexation or disappointment, confessed or concealed. Lanky youths often have long flat chests and wide intercostal spaces in which the heart's action is conspicuous; and it may be a little fretful and suggest hypertrophy. If the patient be "conscious of his heart," or be a little fagged, run down by bad habits, poisoned by tea or tobacco, or the subject of nervous instabilities, an apprehension of cardiac disease may arise even in the mind of the physician. With a little care, however, the true nature of such a case will usually be evident. Attention must be given to a better development of the thorax and general habit of the body as the chief means of cure to which other remedies will be subordinate and temporary. If a specific drug be required, strophanthus or diuretin is, on the whole, better for these persons than digitalis.

Not quite in the same class, however, are the patients who complain of sinkings at the heart, or even as if the organ had vanished out of the body. In so far as such complaints have a mechanical basis they may be vasomotor relaxations, and if so are "real" enough. Tea in some persons produces such sensations of sinking or void; coffee is more apt to set up palpitation or some other obvious irregularity of rhythm. In all cases of visceral distress the interference of alcohol, tobacco, and tea must be suspected and appreciated. The degree of arteriomotor vacillation must be tested by comparing the pulse in the sitting, standing, and lying positions. To stand up ought not to raise the pulse by more than ten to fifteen beats; but in cases of vascular atony it may rise 30 to 50 beats or even more in the minute. Now, with this rise upon him, let the patient lie down flat on his back; the pulse may begin to oscillate, and then almost suddenly fall to the normal, or nearly so; and in these cases there can be little doubt that the failure is not so much in the heart itself as in the tone of the splanchnic vessels, and to this atony our treatment is to be directed. The treatment, then, which in such cases may have been directed exclusively to the heart, must be aimed at the vasomotor system, and should consist of such means as may fortify the nervous tone of

the body. These means are not the same for all persons, and will vary according to the various habits of each. In one the atony may be the effect of some sharp illness from which convalescence is yet incomplete; in another, of severe mental toil or anxiety; in another, of a naturally frail organization, as in neurasthenia; in another, of severe bodily exertion under a hot sun, etc., and according to such several indications the treatment must be decided. A long, restful holiday in fresh air, such as a sea voyage, is very suitable in compassing a thorough cure of such cases: or in young and naturally healthy persons an open air life at such a place as Davos—or at some lower mountain altitude—will prove efficacious. It is unnecessary to pursue this subject as the several methods concerned are fully described elsewhere.

Another kind of vasomotor cases are those of vasoconstriction. Into the causes and symptoms of these cases this is not the place to enter, save as guides to treatment. We may divide them very roughly into the cases of syncope, or rather of syncopoid seizures, when the pulse recedes from the wrist, but the heart, far from receding also, beats more strongly; secondly, into those in which the constriction begins with a gathering cold of the extremities, followed by anxious but capricious attacks of panting, often without distention of the nostrils; an orthopnea not associated with any disease of the heart or lungs other than the temporary disturbance on the sudden rise of pressures; and, thirdly, those in which, the constriction being still more extensive, the pressures are driven still higher, with still more intense dyspnea, throbbings, restlessness, pains, and oppressions, which have been compared with angina pectoris; though the resemblance of such cases to this fell disease is partial and very superficial, even when associated, as it often is, with a violent intercostal neuralgia which itself may set up this reflex and tumultuous vasomotor state. The treatment of these cases usually presents great difficulties; they must be dealt with after the discriminating method we have been considering under the other forms of atony and spasm of the vascular system, from which they differ only in degree; but like spasmodic diseases in general, the attacks are hard to avert and to banish. Vasodilator drugs are more valuable in testing and proving the nature of the disorder than in curing the proclivity to it; still a carefully calculated administration of nitroglycerin or of erythrol tetranitrate may have an influence for good.

Tobacco Heart.—The treatment of this ailment is the simple order to put the poison aside. Tolerance of tobacco is an individual question; some persons smoke all day and seem none the worse for it; others suffer from cardiac irregularities if they do no more than sit in a tobacco-laden atmosphere. When a patient, who is a smoker, consults us about his heart it is almost impossible to ascertain precisely the state of the case until the tobacco has been laid aside for six weeks. Even in ordinary valvular diseases an element of tobacco poisoning may be present, and intensify the disturbance. Where there is no valvular disease, if a definite diagnosis is to be made abstinence is essential, and an abstinence of not less than six weeks. In an obscure case of

severe cardiac irregularity, the patient was ordered by me to drop the weed for six weeks, for the purpose of diagnosis. Had I not exacted the six weeks' promise my treatment would have ended in failure, for during the first month little or no improvement was seen, so that the patient hesitated whether to proceed with the test; but being a scientific man he did as he was told, and a few days later the irregularity passed off suddenly. It did not recur, and he has remained an abstainer. Most men of sense, on finding that tobacco disagreed with them, would likewise abstain; but in many of them after an interval a gradual return to a very restricted use of the drug may be permitted; at any rate until some further sign of poisoning dictates the complete and final denunciation of it. That inveterate smokers in later life are more liable to hyperpiesis, or to atheroma, is an assertion often made and even preached on little or no evidence. I have made careful observations on old smokers, of whom there are many in a university, and am far from being convinced that the incidence of these maladies in them is heavier than on elderly persons generally, including women. We may blame tobacco unduly; a patient consulted me concerning an irregularity of the heart which had increased to a painful and continual habit. Apart from the irregularity, which was but too evident, it was difficult to convict his heart of organic disease. He was still able to play golf and to fulfil the rather arduous duties of a professional life. He was rather a heavy smoker. I told him that I could not form an opinion on his heart until he had abstained from tobacco for six weeks. I did not see him again, but I heard from his brother that he had abstained from tobacco, and that his heart was a little better. It proved, nevertheless, that the cardiac muscle was diseased, for not long afterward I heard of his rather sudden death from "heart failure."

Gouty Heart.—Here again we must discriminate between irregularity due to the "gouty poison" and that of high arterial pressure. I have long taught that gout, that is to say, arthritic gout, is not by any means necessarily attended with high arterial pressure. In the Addenbrooke's hospital, now as I write, is a middle-aged patient, a hotel waiter by calling, whose hands and feet are distorted by chalkstones. These bodies are also to be found in his ears and other parts, and are the result of attacks of articular gout repeated during many years. He is now fifty years old, and his arteries are perceptible, but not very thick. His arterial systolic pressure is at most 145 mm. Hg.—normal for his age. This man, if he were disturbed by cardiac perturbations, as well he might be, would need the antigouty treatment which will be found in the appropriate section of this work. But for cases of hyperpiesis, whether frankly gouty or not, the larger plan of treatment which I have described as proper for this state (p. 157) will be required also.

There are certain equivocal cases of cardiac irregularity which I may conveniently consider here, though their nature is too obscure for precise appreciation; I refer to those not uncommon cases of continuous or even permanent proneness to arrhythmia which are apt to establish themselves in persons, men more usually than women, of and

after middle age. At frequent intervals, especially after fatigue or errors in diet, the heart begins to intermit, to hurry, or to fall into an irregular rhythm; vagaries which are attended with discomfort, a sense of exhaustion, and often with dull precordial pain, and may persist for periods varying from a few minutes to twenty-four hours or more. Once established this arrhythmia never wholly disappears. I cannot give the figures of arterial pressure in these cases, but I may say with some confidence that, at any rate, it is not enhanced. During the more peaceful intervals the stethoscope can reveal nothing definitely morbid, unless it be some loss of quality of the first sound. This state of things is often called "gouty," but on the slenderest grounds of proof; the probability is that in these cases the heart is in some way diseased; it may serve the purpose of a careful life for many years, yet such persons are apt to die, sooner or later, of a sudden heart failure. Sometimes they pass into bradycardia, betraying a deterioration in Aschoff's tracts; but this is not by any means a constant result. That the nervous supply of the heart is intimately concerned seems probable, as dyspepsia will set up the attacks very distinctly; some patients will describe a cardiac perturbation immediately attendant upon the passage of occasional parcels of wind in stomach or in bowel, as instant as if it were a direct reflex; or stress of mind or muscle may have a like effect. Nevertheless, some of these are of gouty proclivity, and if so, by antigouty therapeutics, including colchicum, we may interpret them. Some enormous cardiac storms are gout indeed, and cease as a storm on an access of podagra. In these cases the patient may seem to be in instant peril; his pulse may arise to 140 mm. Hg., the veins of his neck may indicate oppressed ventricles with tricuspid regurgitation, and there may be an agonizing distress. Yet after the podagra the heart may be tame enough for months. Such cases are unsolved riddles.

Our treatment, then, must be empiric; antigouty measures are not to be prescribed without discernment and precise diagnosis; but if decided upon, colchicum should not be forgotten. To send all such persons indiscriminately to spas, and to submit them to the action of laxative waters is pretty sure to do harm to not a few of them. The practice of cardiac exercises is, on the whole, beneficial; but we have to provide first some instant palliative, and thereafter a more abiding remedy. Patients will rarely undertake to have formal exercises inflicted upon them for more than three or four weeks. Our first duty must be to secure the utmost tranquillity for mind and body, and to establish a habit of great caution and moderation in diet. As to foods, the principal is to avoid flatulence (p. 118). Salads, tomatoes, and the like set up distress. Coffee, as a continuous drink, may be injurious, but it is a valuable ally during the attacks; or it may be taken as a preventive before some more fatiguing duty, such as a speech in public. Such a regimen is to be advised even if the patient, as is often the case, is not aware of flatulence, though it is only too evident on percussion. These precautions are to be enjoined as habits rather than tasks or anxieties, for it is bad for such patients to be continually suspecting the heart, feeling the

pulse, or contriving precautions. Some little alcohol is, I think, helpful; a small glass of Manzanilla or Amontillado may be taken twice a day, or a little good hock or claret, or a spoonful of fine brandy or whisky. Half an hour's rest before meals and an hour afterward is to be counselled. But anything like nursing the heart, such as feeding and massage, or continuous repose, should be discountenanced. Even a fair amount of exercise is to be judiciously permitted, perhaps advised, such as gentle horse exercise or golf, but no cross-country riding nor match playing. Cycling may be allowed in a flat country, and with every precaution against racing, urging up hills, or breasting a wind.

During the worst periods, however, rest must be absolute, and diet reduced to milk and Vichy water. Even minor attacks should be parried by quiescence. In the gouty cases, known to be such by a previous history of such alternating attacks, or by other interferences, every attempt must be made to bring on podagra by hot mustard foot-baths, and blue pill and saline laxatives administered. Colchicum must be very cautiously handled during an attack.

In the non-gouty cases bromid of strontium is often very helpful, and during times of greater instability may be continued in moderate doses for two or three weeks; I usually combine the tincture of prunus virginiana with it. Incidentally, but not regularly, the combination of a bromid with caffein is very helpful, and often promotes a significant diuresis. This mixture may be taken in view of an attack, as it is far more difficult to arrest a disorder in full swing than to get the break on before the descent. Strychnin is, perhaps, not to be forgotten, but is rather disappointing. In anemic cases mild iron, especially in the "organic" combinations, is indispensable. Digitalis is rarely appropriate; it is apt to induce a perverted rhythm of its own or to slow the rate unduly. Strophanthus, on the other hand, is of value, especially in combination with carminative additions, of which castoreum sibericum is far the best, but grievously expensive. Is there no hope of a synthetic manufacture of it? The bowels require very careful management; anything like loose motions are positively injurious; they make the patient feel very slack. If, in spite of care, the bowels get behindhand occasionally, a small dose of castor oil, with or without a few drops of laudanum in it, answers best; but such an arrest should be prevented, and this is generally possible by the regular use of some mild electuary, as of sulphur, tamarind, manna, black pepper, a little senna, and the like, every morning or evening; just so much being taken as to promote a soft, but not loose motion. I know of no spa treatment which is of much assistance in these cases; but of many which do harm. Resort to sunny equable climates is usually beneficial, and the more so as in such places the diet is generally more temperate.

In the marches between functional and organic disease of the heart every general practitioner is familiar with the "weak heart" of women, which is prone to appear about the climacteric period. As arterial hyperpiesis may set in at this time and dilate the heart, it is important that the sphygmometer be used to determine the pressure, which even

in the cases now indicated may prove to be excessive; however, in nervous, apprehensive persons the rise may have this origin, so that in them it is very difficult to obtain a true estimate. The impulse is often feeble; both first and second sounds are slapping, and the second sound carries too far, being at least as loud at apex as base. But there is no murmur, nor is dilatation perceptible by percussion. The pulse is small and weak, the ascending curve of the sphygmograph is low, and there is little or no dicrotic recoil. These cases are not "hysteria" nor "neurasthenia"; they may be of autotoxic origin. The more definitely degenerated hearts of this kind will be considered under Heart Failure (p. 152). Hysterical and neurotic epiphenomena will, of course, receive their own specific treatment.

Chlorosis.—Here, perhaps, I may insert the treatment of the cardiac dilatation so commonly discovered in chlorosis. Penzoldt has pointed out that until this factor in the case is averted cure may be much delayed. Fortunately, rest in bed and a little digitalis answer well; and after ten days of this a recovery may set in quickly which iron alone had been slow to obtain. This is, perhaps, the most convenient place to insert the warning, one much needed, not to mistake functional disorder of the heart for organic disease. By such an error not only may therapeutics go sadly astray, but the usefulness of a life may be thwarted or blighted. The error is most easily made when the concurrence of vague symptoms of palpitation, dyspeptic uneasiness, rheumatic or neuralgic pains about the chest, etc., concur with a cardiac murmur which is either transient or is the permanent sign of an old and well-compensated lesion, and, comparatively speaking, required little attention. Yet, I have known persons temporarily indisposed so perturbed by indiscreet advice that a career or prospects of a career have been hastily sacrificed. This is not the place for discussions of diagnosis, but the line of treatment must be to reassure the patient, and to dissipate the dyspepsia, the neurosis, or what not, which had kept up the deception. Unfortunately, when the arrow of an alarmist opinion has been planted in such a heart, the discretion and encouragement of subsequent advisers may be exercised at a great disadvantage, if not in vain.

HEART STRAIN BY EFFORT

The chief difficulty in the treatment of strain of the heart is the determination of the time and of the gravity of the means required for its restoration. In little boys the heart seems as ready to recover itself as to suffer distention, and for this reason we have the fewer definite facts on which to found our knowledge of strain in them. In tender years—say under twelve years of age or so—we frequently hear of faintness, cyanosis, vomiting, and even of collapse—at any rate in a colloquial sense, coming on in the course of a long school run or such effort, and passing off almost as quickly. Rarely do such events so persist as to carry the patient to the physician; a day or two in the sick-room sets the mobile organization right again. But as the boy grows

older recovery is not quite so easy, though far easier than in the adult. In the boy of fifteen and upwards the heart seems, indeed, soon to return within fairly normal dimensions, but to resent the insult, and to remain awhile fretful and turbulent, as if nerve or muscle were over irritable. A brave little boy will run till he staggers, drops, and vomits (because of the vicinity of the medullary centers?), but the resilience of childhood against mechanical stresses is in striking contrast to their susceptibility to toxins, and he will soon recover without long or specific treatment; while such a strain in an adolescent may be followed by restlessness and puffiness on slight efforts. The growing self-consciousness of youth, certain ambiguous causes of nervousness, and nascent impulses or apprehensions, which have not found their due interpretation in the consciousness, reinforce the circulatory instability, and keep the nervous system too much centered upon itself. These cases trench upon the merely "functional" cases with which I have dealt in another chapter. In estimating strain in young persons it is often impossible to appreciate these coöperating factors; yet some approximate calculation is inevitable, for the very repose and confinement which for the strain is appropriate and even compulsory, in respect of the nervous and psychic factors is harmful. The physician, in consultation with wise and observant parents or tutors, must balance these elements of the diagnosis in the individual case as best he can. Speaking generally, however, "heart strain" in boys and girls is treated too seriously. These cases lend themselves too readily to any method of treatment to be overlooked by enterprising "specialists"; and time and money may be spent upon pedantic diagnoses and pretentious systems of cure. Not rarely, it is true, such methods have no inconsiderable suggestive value, as in more purely "functional" heart troubles (p. 122); and, without derogation from honest scruples, the physician may quietly connive at such means at a spa or institution with a guardian who is made aware of the "subjective" nature of the virtues of the fashionable method.

At present then we will confine our attention to the cases which fall strictly into the category of strain; cases which become more definite, more obstinate, and, so to speak, more local as the subjects advance in years; with maturity of years, apart from the supervention of disease, the tissues of our organs become less resilient, their elastic limits are narrower. When matters have gone further than this, when the tissues have undergone a morbid deterioration, strain may determine a grave and insuperable outbreak of symptoms; such as cardiac insufficiency, angina pectoris and the like. In youth, strain is rarely the result of brief efforts, however vehement; in all the spontaneous gambols of young animals the instinct for brief rather than continuous efforts is apparent, and to traverse this instinct by sending youths for long runs (instead of sprints), over long boating courses, and up first class mountains is a stupid blunder. Too often junior masters of public schools make this thoughtless error in tempting spirited boys to make high ascents in the Alps, excursions not only too protracted for their years,

but the more trying both to mind and body in so far as the youth is probably unskilled in the practice of this arduous pastime, and is in emulation with persons who, if not bigger, are older, stronger, and maturer in mind than himself.

So far, then, for preventive treatment: when the strain is really inflicted and in the acute stage of panting and often of precordial pain, alcohol, strychnin, and like stimulants are mischievous. Syncope, in which state they may be needed, is a less frequent event, and usually, indeed, signifies general exhaustion rather than cardiac strain. In case of strain, with dilated heart and rapid, feeble, or flickering rapid pulse, the patient must be laid down with his shoulders raised, and his clothing slackened, especially, of course, about the chest and neck, and warm wraps put about his legs and feet. He must have plenty of air around him, but no food, drink, or medicine, unless perhaps a little coffee or hot water. Some help may be given to the respiration by slow and rhythmic chest compressions, but not by moving the arms or trunk, which, in a conscious patient, arouses consentaneous voluntary efforts. So long as he can breathe at all he will desire to be let alone.

After restoration from the acute stage we shall try to estimate the disability of the heart itself. Whatever its drawbacks, and on these we have touched, muscular rest will be imperative for some long time. In a case of any severity it must be rest in bed, under the conditions mentioned in the paragraphs on nursing cardiac patients (p. 113). Liberty of movement to easy chair or couch leads to carelessness, and insensibly the patient takes more and more effort upon himself. So long as the dimensions of the heart are excessive the bed rule must be insisted upon. The progress of the case will be roughly estimated by the cardiac area, but still better by the extent and undulation of the heart beat. The cardiac innervation suffers as well as the muscle, and these patients usually look anemic and present hemic murmurs. The anemia is often curiously persistent after the cardiac symptoms have receded. Gradually a little unexciting mental attention may be permitted, or, indeed, for its disciplinary value commended. The diet must be reduced in proportion to the muscular inactivity, and the excretions regularly solicited. After the first few weeks massage will prove a wholesome and suitable assistance.

In respect of drugs, the bromids are occasionally useful both for some soothing influence on the heart itself and for their influence on the nervous "fringe" of the case; but the use of them should be intermittent and the doses moderate. If the heart be bumping and fretful a few very small and occasional doses of tincture of aconite may be administered and under vigilant observation prove helpful; but if the condition be rather one of the diffused wave of dilated chambers of course such a drug is to be deprecated, and more bracing remedies preferred. Of these no doubt digitalis is the best; and in the cases under review is well tolerated. It should be given in small doses and in five days' courses. Thus it may be administered for a considerable time; but diuretin often answers even better as a continuous medi-

cation, the digitalis being periodically added to it and withdrawn. In the more tenacious cases much patience is needed both by patient and friends if a steady progress to health is to be maintained; and much judgment is required in taking the steps from inaction to the activity which general well-being may demand and cardiac capacity may not forbid, lest we make "crocks" of youths substantially sound. Cactus grandiflora I have found very useful in convalescence, and it may be used with good effect over long periods of time. I often combine it with tincture of prunus virginiana. Cardiac stimulants, such as caffein, are not indicated after the first or critical period.

From these comparatively transient cases in young persons we may pass by insensible gradations to the grave and too often permanent strain of older persons, injuries to which pre-existing deteriorations, whether constitutional or infective, often contribute in greater or less degree. Such constitutional factors are atheroma or excessive arterial pressures, or infections, such as syphilis, influenza, and the like, or even common catarrhs "of influenza type." The physical strain may be salient in the causation, or, in the presence of such an infective or constitutional factor, it may be only a contingency. The treatment will vary accordingly; that is to say, the enjoining of rest must, in the individual case, depend more and more on the intrinsic disease, as the factor of stress was nearer and nearer the average level of the efforts of ordinary life. The more, of course, the intrinsic defect, the less the effectual element of strain until, as a factor of treatment, strain becomes almost negligible, and cases of this character fall rather under such paragraphs as cardiac insufficiency, angina pectoris, aneurysm, etc., to which the reader is referred. To ascertain approximately the element of strain in the individual case may be rather a matter of prognosis than of treatment.

Cardiac Strain Under High Arterial Pressures.[1]—By an easy transition we pass from such strain of the heart to strain produced not by incidental muscular stresses, sudden or protracted, but by the prolonged, gradual, and too often insidious stresses of inordinate resistance in the peripheral circulation. By such a persistency the most enduring heart is defeated at last. Whatsoever the causes, and into them this is not the place to enter except in so far as they illuminate treatment, the remedies are practically empirical; but if timely are not insufficient. In timeliness lies their efficiency. If we are alive to the gradual and stealthy establishment of high pressures, and of the consequent alterations of the vascular system to meet them, if we are quick to measure at proper intervals arterial pressure in middle-aged persons complaining of tedious symptoms however vague, we shall succeed in preventing the commonest cause of "heart strain" before it has done irreparable injury. Let us suppose the arterial pulse too evidently labored and too long sustained, the apex of the left ventricle a little out to the left, and the aortic second sound suggestive of excessive tension; then, if we discover this in time, we may stop things from getting worse, and reason-

[1] See also Arteriosclerosis (p. 155).

ably hope for permanent recovery. The condition is prominent in chronic interstitial nephritis, but as it is frequent enough independently of renal disease in any clinical sense, it comes before us in this section.

The means are emunctory, and in the sense of discipline ascetic; they are disciplinary in diet and exercise. In later stages of the malady we can hope for no more than respite and palliation, for in response to the abnormal stresses the vascular system will have received a new and permanent set, and some better or worse compromise is all we can expect. The principles of treatment are then modified by the need of some support to the heart, according to its stage of fatigue. In more extreme degrees such a heart may be regarded as relatively insufficient, and the therapeutics of insufficiency are described elsewhere. Thus the case may become one in which, even in the face of excessive arterial pressures, digitalis may be appropriate, for we have in such straits to assume a higher state of pressures as inevitable; the overtaxed heart must accept the position, and avail itself of digitalis and its congeners to meet an abnormal exaction. Happily, the hypertrophy is surprisingly enduring, and within prescribed limits efficient, for when the vascular system is stretched and its capacities altered the reduction of pressures cannot without discomfort and instability be carried beyond certain limits to be recognized in each particular case; yet what can be done must be done to reduce the arterial pressures, not, indeed, within the limits of health (this is no longer possible), but yet to some abatement.

It would be a very unfair as well as an unfruitful imputation to accuse every person found with excessive blood-pressure of immoderate habits at table, or of indolence. It would seem that whatsoever this perversion of metabolism may be, it is one which arises far more readily in some persons than in others. In some persons gluttony escapes without its penalties, at any rate before the pathologic tribunal; in others, even innocence pays a penalty—the *multatio misera bonorum.* It may lie in an inadequacy of the ordinary nutritive and excretory processes in the individual, in which case he must manage himself in subordination to his natural incompetency; or he may be susceptible to the presence and interference of autochthonous microbes which normal persons are able to resist and ignore. The remarkable efficiency of calomel and other mercurials in this malady may be due to their bactericidal quality, though more probably to relief of the portal system. Where calomel is well tolerated—and this is in the majority of cases—its effects in relieving the malaise and mischief of hyperpietic processes—are ready and encouraging, and this long after cure has gone out of the question. Pressures, however, are moderated, and the patient experiences a relief from vague depressions and inabilities which no other drug so quickly effects. If calomel be ill borne, blue pill may conveniently take its place. For an adult my practice is to administer the calomel in fractional doses—say about $\frac{1}{4}$ grain—or even less—twice or thrice daily for five days. Then I suspend it indefinitely, returning to it as the indications may be, and meanwhile prescribe in small doses—say $\frac{1}{12}$ or even $\frac{1}{20}$ gr. with each meal—continuously, podophyllin or euonymin.

More or less contemporaneously with these alteratives I order saline laxatives—such as some palatable form of sulphate of soda (without the chlorid) in a moderate quantity of hot water every morning, for about four weeks. At first the saline is "depressing"; but in a few days, in most persons, this effect passes off; and the medicine is often taken habitually as an acceptable and even "tonic" remedy. One lax motion after breakfast is all that should be desired. I do not now administer vasodilators systematically; when the vascular system has become adapted to the abnormal standard of pressures they are not well borne, and in the stages of initiation remedies of a more radical nature are required, remedies directed to causes rather than consequences. At times of urgency, however, when by their severity pressures are instantly endangering the integrity of the body, when cardiac failure or an apoplexy may menace us, an attempt to reduce pressures immediately seems imperative. For such a purpose no drug has yet superseded nitroglycerin in alcoholic solution, as recommended by Binz. The doses are increased from $\frac{1}{100}$ to $\frac{1}{50}$ gr. or more. Unfortunately, tolerance is readily established. The effects of erythrol tetranitrate last longer, but, if more than a few doses are required, it is rather expensive for ordinary use. It must be remembered, however, that in the presence of cardiac distress to reduce arterial pressure by nitrites is a two-edged expedient. In cases of urgency the best practice is to open a vein. But when a heavy stroke of apoplexy has taken place the problem is a very complex one. Crile, Cushing, and others have demonstrated that a high pressure may be conservative, for as a sudden rise of intracranial pressure tends to anemiate the bulb, to secure the performance of its vital functions an enhanced intra-arterial pressure may be an essential condition. A careful appreciation of all the factors in the individual case may give us a clue to a safe course between these alternatives, and a knowledge of the previous history of the patient is, of course, a valuable aid to a sound judgment.

We cannot well omit these reflections which meet us in too many cases of persistent hyperpiesis, though our business is more directly with that termination of the malady which declares itself in defeat of the heart. We have seen that stretched, labored, and fatigued to exhaustion the faithful servant at length gives way, the left ventricle dilates, and a mitral regurgitation may be established. Too often in this crisis the heart is accused, not of failure in an unequal fight, but of intrinsic frailty. And, indeed, unless the patient has been watched for some time, discrimination is often difficult; especially if the arterial pressures have not been measured. By the sphygmometer, however, the arterial pressure will be found excessive; even a failing heart in hyperpiesis is often sustaining a pressure of 180 to 200 mm. Hg. or more, whereby we learn that the organ is not undergoing essential decay but overborne by excessive labor. Nevertheless, the patient must be put to rest and treated as one with cardiac insufficiency, for such it virtually is. The chief symptom is usually dyspnea, and the breathlessness sometimes comes on in attacks of agonizing intensity.

Anasarca is slight, and pulmonary and hepatic engorgements may be yet to come. Time may therefore be taken to assist the heart gradually back to some approximate equilibrium, even by a cautious use of digitalis. But before incurring the risk to the brain of reinforcing the arterial pressure, measures must be taken to reduce the peripheral resistance by alterative, eliminative, and dietetic means. It is, then, in subordination to these that drugs of the digitalis group may be applied, not in a routine fashion but adroitly and tentatively. Thus we must call upon the heart to cope as well as it can with a state of things which, at best, can but terminate in no long period in its defeat, or by cerebral hemorrhage. Still it will probably be in our power to diminish the peripheral resistance more or less, and thus for some months or even for a year or two, to maintain the precarious balance. When, however, dyspnea has once shown itself, the patient rarely survives for more than twelve months.

It is remarkable that in these cases exercises, at first sight so inappropriate, find nevertheless some justification in practice. Under the skilful and tentative use of the gymnastic, the pulse, intermittent, somewhat accelerated, even irregular as it often is, becomes slower and more even in rhythm. By these maneuvers a pulse of 84 to 100 may recede to 74, perhaps, and the arrhythmia, if not dispelled, be much moderated; and meanwhile such drugs as digitalis must be remitted, if only to avoid confusion. In this, as in some other forms of heart disease, death, when deferred for a time, when the symptoms, indeed, seemed for a while to have been alleviated, may at length come suddenly.

In many cases the mitral valve is so forced by the high pressures that the ordinary results of this defect ensue, as in essential heart failure. In hyperpiesis this event may be the result of some occasional effort or fatigue, recognizable as such.

In old persons, with thick arteries perhaps, but no persistent high arterial pressure, a complaint of disordered function, coated tongue, loss of appetite, depression of spirits, often leads to a note of temporary hyperpiesis. By calomel and the other measures just described the disorder is subdued and the circulation permanently restored to the normal.

CHRONIC VALVULAR DISEASE OF THE HEART

Mitral Regurgitation.—We will begin with this kind of chronic valvular disease, because it is in itself a compendium of heart alteration, and yet is the kind most amenable to treatment. It is the general experience of physicians that patients suffering from moderate degrees of this malady may and, if the nutrition of the heart stands good, often do live for twenty or thirty years, and in the enjoyment of fair health and activity. Unfortunately, the nutrition of the heart does not always stand good; it is liable to deterioration by intrinsic defect, by increase of the lesion, and by the consequences of noxious habits or conditions.

It is better then to enter upon the treatment of mitral regurgitation

in respect of the promising cases, and of these the mitral regurgitation of acute rheumatism in young and otherwise healthy persons is, of course, the most promising. The mitral cases of strain and of hyperpiesis are dealt with under their proper sections (pp. 131, 134). Here we shall consider the mitral regurgitation of valvular disease and of muscular insufficiency in so far as it pertains to the heart itself; but convenience dictates that the regurgitation which is rarely absent from stenosis shall be taken subordinately to this disease.

Hypertrophy of the left ventricle is a part of the natural accommodation in mitral insufficiency; we must therefore take this as a guide to treatment. The disadvantage of the regurgitation lies in the proneness to a relative fall of arterial pressure, and this for obvious reasons. All means of promoting the tone and nutrition of the cardiac muscle, which we have separately considered, must be brought to bear in mitral disease; and fortunately in this state we are not met by contingent qualifications as we are in many other morbid states; we have a free hand to follow the main indications. If the muscle is sound we have to keep it so; if not we have to restore it, if we can. The degree of soundness we may ascertain by the history of the symptoms, by the characters of the case, by test exercises, etc. It is in mitral regurgitation, then, that digitalis has its unembarrassed use and its fewest drawbacks. Now, digitalis loves a sound muscle, such as the cardiac muscle of a young person who has put well behind him the infection in which the valvular injury originated. Until the conditions of the artificial balance are in the individual case well measured, and the corresponding habits and provisions duly systematized, slight strains are apt to occur; and the first duty of the physician is to determine their degrees, and to anticipate the provocations by which they are set up. In a large proportion of such cases the restrictions laid upon the patient will not be very burdensome. Young persons with mitral regurgitation after acute rheumatism often play football and cricket, some years later, with impunity; though I need not say that such happy-go-lucky conduct cannot be compatible with reasonable precautions, not even after an individual experience of immunity; for one occasion of overstress may not be atoned for by the subsequent self-denial, and the heart may be thrust down once for all into a permanently deteriorated state. As soon as the valvular defect is recognized patient and physician must both for a while watchfully measure the effects of exertion, not only when the patient is at his best, but also during those temporary fluctuations of health from which the most fortunate of us are not free, but of which normal persons can afford to take little or no notice. If by ill hap the mitral heart has suffered some strain, all the means of rest, diet (milk), and other remedies of which we have already spoken must be put into play, and continued for too long rather than too short a period of time. As soon after the strain as the several functions of the body are set straight, digitalis will pretty surely be the mainstay, and will be administered on the principles already described (p. 68):

For children:

℞. Infusi digitalis,
Infusi sennæ,
Infusi calumbæ..... āā ℥j.—M.

S.—Thrice daily before meals. A few drops of acidi nitrici diluti (Eustace Smith) may be added if desired.

Generally in mitral regurgitation toleration and amelioration may be reckoned upon. These considerations are especially true in respect of static regurgitations arising from definite infections, and belonging to the first three decades of life.

Mitral disease, unless of long standing and previously overlooked, is rarely manifested between thirty and forty years of age. But with advancing years its frequency increases, when conditions of a degenerative kind are then among its principal causes. Moreover, after the age of forty the mitral patient must regard his margin as more precarious, and watch himself more closely. Sclerosis is prone to invade the upper curtain from the aortic area. On the other hand, to make his heart a bogey to him may be as bad or even worse than the neglect which, at any rate, spares the heart the maleficent influences of mental vexation. In advancing years the evils of sedentary life and self-indulgence tend to the deterioration of the cardiac as of the other muscles, and to discover mitral regurgitation then is to suspect something worse than mere static valvular defect; it is to suspect degeneration of the muscular structures by which the valvular defect is to be counteracted. Now digitalis can no longer be our routine remedy, nor, perhaps, even our mainstay. The case may be one of obesitas cordis, or fat heart (p. 150); but if it be one of cor adiposum, or "fatty" heart, we must endeavor to measure the degree of the deterioration, and to counteract all those conditions which might make for the progress of the disease. We must inquire if the fault lies chiefly in the valve, or if the muscle be but temporarily deteriorated, and capable of restoration; if there is a static defect of the valve or orifice, or only a relaxation which may not be irreparable. In some middle-aged men who have lived too well a mitral murmur will cease on rigorous regimen and graduated exercise. In men a little older the valve may be undergoing sclerosis. To get an answer to these questions the patient must be put to bed, his arterial pressures and transverse cardiac diameters measured, and the effects of experimental efforts upon them noted; any constitutional error must, if possible, be counteracted. Bad habits must be arrested and better ones initiated, and after this initial period test exercises must be tried from time to time to ascertain the capacity of the diseased organ. Digitalis will be *one* of these tests; for if the heart takes kindly to it we may entertain the more hopeful opinion. Cases in which muscular disintegration is the salient factor will be considered under such failure (p. 152); here we have rather to look at the effects of mitral regurgitation as a breach in the defences of a heart otherwise fairly good.

The first and chief effect of the regurgitation is to raise venous pressures, primarily the pulmonary; so that the venous currents, on the systemic side always of low velocity, become still more retarded.

The object of treatment is to restore the velocity as far as may be. Of the part played by the vasomotor and cardiac properties of digitalis in raising arterial pressures, and in retaining the blood in the systemic vessels, we have already spoken (p. 68). In mitral diseases the arterial pressures should be about normal. The right ventricle is hypertrophied against the rise of pressure in the left auricle so that the regurgitation may be withstood; the left ventricle grows larger and stronger to meet this enhanced pressure, and, happily, the lungs seem able to withstand no inconsiderable increase of stress. It seems too that even a slight excess of CO_2 in the blood, by stimulating the vasomotor center, helps to keep up the pressures. We have seen also that before the administration of the foxglove, we must do what we can to rectify the sluggishness of the secretions and excretions due to the venous retardation in several areas; before hoisting the mainsail we must get the vessel clear, and of this too we have said enough. But let us suppose by the more or less insensible accumulation of arrears, or by the gravity of the lesion, that the lungs are, in von Basch's language, swollen and stiff, so that the strokes of the respiratory pump are shortened, the organs in the portal area are congested and embarrassed, the legs swollen, and so on: how are these torpid parts to be drawn into action again? If the patient cannot lie in bed, and the sitting position with feet down is the only possible one for him, so that the legs become more and more distended, and the skin threatens to break—if these features of a state too familiar to the reader to need description are before us, how can we so interfere for good as to bring the patient within the scope of digitalis, a drug which in any case, indeed, will take some three days or so to make itself felt. In these cases, when the unhappy man scarcely dare drop into slumber lest he bounce up with an agonizing start, the use of morphin comes to our help (p. 91); by it we shall reduce the air hunger and soothe the respiratory spasms. This remedy may be needed three times on alternate nights, a measure which, in a case with any future before it, usually suffices. The nurse also may be provided with a cordial; or the digitalis and mercurial pill may be tried; or the combination of digitalis with diuretin. For attacks of dyspnea, often nocturnal, subcutaneous injections of atropin are useful. If there be some fluid in the pleuræ, let it be drawn off on one side or both, and its albuminous content estimated. This proceeding often gives much relief and never leads to harm. Acetate of lead is of some service in early edema of the lungs, and calcium chlorid or lactate is supposed on abstract argument to postpone these exudations. For hemoptysis no drugs are needed. If the legs are perilously distended they may have to be relieved operatively, as described (p. 98), and this operation must not be deferred until the skin begins to suffer. A free and prolonged oozing may carry off great quantities of fluid and give prodigious relief. If time be allowed to us, however, less alarming means may enable the patient to return to bed, when by massage and saltless diet the anasarca may be dissipated more conveniently. As soon as the congestions are got under I usually administer Nativelle's or Homolle's digitalin with the precau-

tions already laid down. The diet and general management must be carried out on lines laid down on pp. 113 and 118, remembering that dyspnea, if often mechanical, may be in part also a gastric reflex, or due to some toxic errors of diet. For the administration of mercury as a diuretic, see p. 97.

It is astonishing how high a degree of recovery a patient may attain if he can be rescued from this morass of symptoms, at first sight so unpromising. Over and over again such patients are enabled to enter again into home life, and even into public activity. Not long ago a gentleman, whose advanced age and arduous life made substantial amendment from this state improbable, was rescued by such means; and some months after my last visit I heard from a friend of his that the night before he had taken the chair at a public meeting. It is very difficult to say, even in old persons, when the potentiality of such a heart is finally exhausted; hope may be entertained almost to the last. In the case mentioned, the patient had lived a temperate life in respect of food and drink, though not in respect of intensity of mental and bodily exertion. On any favorable turn of the symptoms prognosis may be aided by estimates of the jugular-carotid curves after the method of Dr. James Mackenzie, and of the arterial pressures by the sphygmometer. (For stages of amendment, see Baths and Exercises.) For other resources in case of difficulty the reader will refer to the paragraphs on the several drugs, etc

Besides the mitral regurgitation of past valvulitis, and that of slackening cardiac energy, there is at least one other kind of great importance—namely, the forced regurgitation of a ventricle yielding under excessive arterial pressures; of these that of aortic regurgitation is the best known. But even more frequent is the forcing of the orifice under excessive pressures due to hyperpiesis. The effect on the mitral area is the same in both cases, and is the initiation of the last stage of these maladies. The lungs under enormous stress, as in Bright's disease, for example, are stifled; dyspnea is but too evident, and the machine is far on the way to destruction. The little that can be done to ward off the inevitable, and to soothe the sufferer, is discussed under the heads of Aortic Regurgitation and of Arterial Hyperpiesis (pp. 114 and 157).

Adherent pericardium (mediastinal synechia) is even more apt to be attended with severe and persistent dropsy, often both ascitic and anasarcous, than mitral disease. But the problems are essentially the same, and the remedial means are those proper to dilated heart. The surgery of these cases is discussed on p. 171.

Tricuspid regurgitation from the point of view of therapeutics may be regarded as a graver degree of mitral regurgitation, and, in principle, the treatment is the same. The more exacting methods, however, such as baths and exercises are rarely applicable to tricuspid insufficiency. Happily, in many cases, as in toxic myocardial affections or forced pulmonary stress, it ceases as the conditions return toward the normal. Indeed, the old phrase "safety-valve action" may be applicable to tricuspid regurgitation even in grave cardiac disease; it reduces

the stress upon the lung and left auricle and seems in respect of its own function to have some recuperative capacity. The therapeutist who becomes aware of its supervention, let us say in a case of mitral stenosis, may be guided in his methods by it and the jugular pulse.

Mitral Stenosis.—When this condition begins to tell, with or without regurgitation, and regurgitation is rarely quite absent, our difficulties are greater. Poynton says the stenosis gains on the regurgitation. The excessive pressures in the pulmonary circuit are due here not to an embarrassed function, which may admit of reordination and always of some elasticity, but to a fixed parchment-like barrier, a barrier, moreover, which gradually draws tighter and tighter. By the strengthening of the right ventricle the velocity of the stream through the slit is increased and increased, but as the pressure thus rises the resistance of the lungs is grievously tried. Even if it be true that digitalis acts preferentially on the right ventricle, we do not avail ourselves of this advantage without apprehension of injuring the lungs. That hemoptysis is an early symptom does not surprise us, and our treatment of it is not to be hemostatic, but expectant; if we do not welcome the blood-spitting, at any rate we perceive some incidental and temporary advantage in it. That the lung should be ruptured is bad, but it is well enough that some relief should be given, even by unnatural means. As in mitral regurgitation so in stenosis, but even more urgently, we shall use indirect means to relieve the venous stasis. Venesection, rarely necessary in mere regurgitation, may in stenosis become almost imperative, even in earlier stages. A few leeches or the cupping instrument may be used at first, but later venesection may be imperative. Ascites, a more considerable feature than in mitral regurgitation, manifests itself in not a few cases of stenosis, and it is in this form of heart disease that the paracenteses, described on page 99, are more frequently required. Rolleston says this is due to the heavier and more protracted congestion of the liver, leading to a sort of cirrhosis. The establishment of stenosis is usually a very gradual process, its earlier phases being often latent; but during these phases, if discovered, it is hard to see what medicine can do beyond the promotion of the general health, and the enjoining of precautions as to exercise and the the like, on which we need not again insist. In a few cases I have recommended the use of fibrolysin, by intramuscular injection, for forty-five to fifty repetitions, leaving the heart to do its own massage of the orifice; but I have found it difficult to persuade young people, not feeling ill, to undergo the course, especially as the result would be very problematic. Still I think it is worth while to take the chance. Young men who have contracted this defect must avoid tobacco and alcohol. But above all things catarrhs of the air-passages are to be avoided; and patients who are not otherwise attached by engagements should reside in genial, dry, and equable climates.

When the latent period is passing and symptoms of closer constriction begin to assert themselves, when the pulse loses its regularity and pulmonary congestions become but too manifest, nitrites have been

recommended, with the intention of finding room in the arteries for the blood which is distending the pulmonary circulation. Unfortunately, in this counsel it is forgotten that to dilate the arterial periphery is to let the blood run out of this area into the veins again; and as a matter of experience in mitral stenosis I have not found any advantage in the use of the nitrites unless it were in some occasional state of oppression, for which, indeed, other remedies are better adapted. We find the arterial pressures higher than the mechanical conditions would suggest, and probably to keep up arterial pressure on the bulb a general vasomotor constriction is set up which we ought to respect, even at some cost to the heart. For the same reason large evacuations from the bowels are to be avoided; the portal processes must be kept alive by more gentle means. In dyspnea, or nervous starting, tincture of hyoscyamus and spirit of chloroform with a little stimulant often give some relief; and a belladonna plaster over the region of the heart will often relieve the sickening ache in this part. Urgent bronchitis is best treated by large doses of ammonium carbonate:

℞. Ammonii carbonatis..... gr. xv–xx;
Sodii iodidi..... gr. ij;
Tincturæ scillæ ..... ♏xv;
Aquæ camphoræ or infusi senegæ..... ℥j.—M.
S.—To be taken three or four times daily.

In mitral disease, especially in stenosis, clots are apt to form in the auricles and elsewhere, and if detached to cause terrible distress and peril to life. We are told, therefore, to avoid the use of lime salts, or of much milk, and to order a daily dose or two of citrate of ammonia. An attack of respiratory spasm with a local pleuritic rub would, in case of doubt, point to this event in the pulmonary artery or lung. In case of pulmonary infarct the hemoptysis itself may be disregarded. If the fight for breath be grievous and prolonged, a small dose of morphin is to be injected under the skin, and measures taken to promote the action of all the respiratory muscles, to which some manual aid may be adroitly given. The heart may be supported by cordials, and by camphor subcutaneously.

Aortic Stenosis.—This is said, not without truth, to be the least of the cardiac diseases. It is the least so long as the heart muscle is fairly sound, and so long as it does not advance on any one or more of three lines—namely, extend to the implication of Aschoff's tracts, so trenching upon the conductivity of the cardiac muscle; increase with the atheroma of which it is often a part; or, lastly, proceed to so great a degree of constriction that the pressure head in the aorta can no longer be maintained to degrees compatible with life. It is amazing, however, to see by necropsy the degree of constriction to which the orifice may shrink and yet be compatible with the continuance of a narrow life. If the constriction advance slowly enough, the cardiac muscle will grow up to the work even in spite of obliterated coronary orifices. In some old folks the blood seems finally to have been driven through an orifice

as small as a knitting-needle. The best we can do is to maintain the value of the blood itself. The treatment of atheroma is discussed in its own chapter (p. 155); and the little we have to say of the degeneration of Aschoff's tracts will be found elsewhere. Many cases of aortic stenosis neither spread fibrosis nor, indeed, depart from a static condition; and under these circumstances need no treatment. The dilating stresses are not severe, and, in persons otherwise healthy, the needful hypertrophy of the left ventricle is attained with little difficulty. Digitalis and its congeners are rarely required. Aortic stenosis, however, too often forms a part of states graver than its own, when the circumstances rather than the concomitant conditions will determine the treatment.

Aortic Regurgitation.—This fault arises in two chief ways: by direct injury to this valve alone or to both this and the mitral valve, the rest of the heart being healthy; or by extension of disease from the aorta to its valve. The first business of the physician, therefore, is to ascertain the cause of the aortic disease—if rheumatic, if syphilitic, if atheromatous, and so forth. The most urgent of these questions is, Is it syphilitic? As syphilitic aortitis begins often, if not always, above the valve, it is of vital importance to detect it early by such a symptom as "sternocardia." In this stage vigorous specific treatment may save the valve. And, if the valve be already involved, I have had reason to believe that the disease may still be corrected and no little recovery of the parts attained by the energetic use of iodids and mercury. (For method, see Angina Pectoris, p. 162.) I have said that in degenerative disease of this area, even, indeed, in the advanced coronary atheroma of old persons, if it has progressed very slowly, we may find the heart's muscle fairly sound. It is rather with mitral inefficiency that intrinsic degeneration of the cardiac muscle is associated, to which, indeed, the valvular defect is often subordinate. Nevertheless, aortic regurgitation brings life to a more or less premature end, and death may come by muscular defeat; not infrequently, indeed, with a consequent mitral regurgitation. In the simple cases of aortic regurgitation the physician has to ask himself, according to the principles we have laid down (p. 61), whether the case is one of a fair stability, or is progressive? Again, if progressive, is it so by increase of the defect in the valve or orifice, or by an inability of the muscle to counteract it? To counteract the backlash, cardial tonus is probably increased, while peripheral tonus is relaxed; but if at any moment or period cardiac tonus be relaxed, the elastic limit may be overpassed, and molecular strain with minute subinflammatory reaction may set in, and result in a patchy fibrosis at the necropsy, to be distinguished from the callous patches due to coronary decay. And in the case of advancing valvular inefficiency the practical man must ask himself if this depends on the progress of the disabling disease, or on the degree of the injury being such that locally the lame valve is giving way more and more under ordinary stresses; in the case of inability of the muscle he will ask, likewise, how far the progres-

sive failure depends on an intrinsic deterioration, due perhaps to coronary disease, how far on the magnitude of its abnormal task. Suppose we take a mean position—that the valvular defect is moderate and the muscle capable, under favorable conditions, of coping with it; but that in the rough and tumble of common life the heart has gotten behindhand. Under these unfavorable circumstances the long pause will be encroached upon, and fatigue will appear as that form of "asystole" which consists in imperfect output with accumulating residual blood; in other words, we have to combat rising contraction volume and falling output with consequent systemic and cardiac anemia and a contraction disadvantage geometrically rising, a moment when a vagus demurrer might put a sudden end to the case. In this dilemma we must reduce or arrest physical exertion so as to diminish the current calls on output, the volume of the overcharged ventricle, and the overload of the muscle. We see cases in which an aortic regurgitant condition with fair stability is impaired by an intercurrent attack of some passing infection, such as influenza; and the impairment may be grievous. Absolute rest must be enjoined in these cases, that the pulse rate may come down to the normal. Strychnin, arsenic, diuretin, and perhaps, intercurrently, digitalis will be our main remedies. No question of exercises, however adroit, can be entertained until the contents and the diameter of the ventricle are moderated. With every unit reduction in diameter we shall secure a cubic advantage of contraction, and till the balance is thus restored the system and, unfortunately, the big heart also have to be content with less blood.

So long as the mitral orifice is not forced, or the valve not much held up, venous pressures are not rising; the left ventricle will be extended outward, but on the venous side no important changes will be perceptible. On the systemic side the best vasodilator for the reduction of friction is warmth; generally by confinement in bed for a sufficient time. This time will be determined by the behavior of the pulse, the better supply of the brain and heart with blood, and the return of the ventricle either to certain known dimensions—those of its former state of compensation—or, in case of no known standard for the particular case, those which seem best compatible with a regulation of the symptoms, cardiac and systemic. Generally speaking, though here the higher pressures of the aorta are certainly an adverse factor, the blood will pour into the ventricle more readily from the auricle than from the aorta. It is a helpful rule systematically to note the intensity of the pulmonary second sound, as an emphasis of this sound would suggest that aortic is prevailing over auricular influx. As equilibrium is established, the effects of bodily exertion will be watched, degree by degree, appreciated, and regulated (see Tests, p. 66). In this stage of the disease no medicines may be needed except for such temporary purposes as the regulation of the secretions. As the contraction volumes of the blood are reduced, the ventricle will gradually master its contents, and on its successively more complete systoles will approximate more and more nearly to evacuation.

In aortic regurgitation, especially when recent, the left ventricle, agitated by stress of work, and often a little behindhand, often becomes irritable or even turbulent; and from associated irritation the whole arterial system is liable to disturbance. A throbbing of the compensatorily slackened walls rocks the whole cardio-arterial system. If aconite could ever be suitable in heart disease, it was in aortic insufficiency; but we have safer means in an application of the ice-bag or cold compress. The bag may be applied to the spine in the lower cervical and upper dorsal region, or directly over the heart itself. The diet must be very light, and the stomach guarded from flatulence; to secure absolute rest the bromids may be given; or even a dose or two of morphin, such as $\frac{1}{8}$ gr. under the skin, may be justifiable. Atropin in this state is harmful. It may be some time before the diffuse pulsations, uneven rhythms, and throbbings subside, and a more orderly action is established; but simultaneously with their abatement the left ventricle will gain tone and withdraw within narrower limits. The subjective symptoms will also evanesce, for in his tranquil periods it is surprising how little conscious a patient may be of the vehemence of a big heart which is but too evident to the bystander. Rest should continue for some little time after this alleviation, for the heart to recover its nutrition and reserves; to this end iron and a careful dietary will co-operate; then gradually its endurance will be tested by the usual means, and the patient restored to active life by such degrees as may prove in the particular case to be practicable. If the aortic damage is associated with subinflammatory changes about the aorta, which are apt to occur in toxic aortovalvulitis—*e. g.*, in rheumatic fever, influenza, and especially in syphilis—close attention must be directed to the intercurrence of any symptoms of this kind, such as substernal oppression, and slight rises of temperature, such as 98.5° F. of a morning. Signs of aortic dilatation may be detected at the suprasternal notch, by displacement of the subclavians, by dulness in the right second space, and so forth. If aortitis be probable, vasodilators must be cautiously administered, and the restrictions mentioned above more rigorously enforced. These cases of suprasigmoid aortitis with peril to the valve are tedious; and many months may elapse before all indications of morbid changes subside, morbid changes in the very fountain of life. When the mischief is syphilitic, specific treatment must be prompt and intense, as, for instance, by subcutaneous injections of mercury or inunctions.

When the patient gets about again it will be necessary for some months afterward to watch the degrees of readaptation very closely: as stability is attained, once in six months will do, but the heart should be examined every six months at least for the rest of life, and a re-examination made on any deviation from health—such as "biliousness" or "bad colds," as well as for discomforts more obviously cardiac. It is of more importance in aortic regurgitation than in any other heart affection that the patient should form habits of equability of demeanor in all things. That when death in aortic disease is to come it may come

suddenly, may be no misfortune; but a single inconsiderate effort, such as hastening to a train, lifting a weight, or jumping over a low fence, may precipitate the stoppage of a heart which had stuff in it for a while of well-husbanded function. Not only so, but, if death be not instant or imminent, such an inadvertence may upset the artificial balance, and a dilatation be established which no after-care may quite succeed in overcoming. In one such severe, but fairly stable, aortic case the patient had to hasten to the bedside of a dying kinsman far away; the effort was trying and laborious, and contrary to our advice as physicians, although as fellow-men we could not withstand his determination; the toilsome journey and stress of mind were followed by a further dilatation of the heart, a mitral insufficiency ensued, and in spite of the utmost care, the end came in a few months. The treatment of aortic regurgitation with these sequences coincides, on the whole, with that of cardiac dilatations of other origin.

But there are special points of management; for instance, many physicians are convinced that in aortic regurgitation digitalis is untrustworthy; even under conditions which, if of other origin, would dictate its use. They think that in aortic regurgitation conditions are present which make the use of digitalis perilous. Even the strong encouragement of physicians such as George Balfour, who assert, too unguardedly perhaps, that no such timorousness is to be excused, has not succeeded in dispelling this prepossession. If the pulse of a heart with aortic regurgitation becomes intermittent there may, indeed, be no ground for the common alarm of failing fiber; intermittence may appear years before the heart begins to perish; but it is a disquieting condition nevertheless. Even if it be but an extrasystole due to a dyspeptic stomach, or some gouty or other impurity of the blood—there is a risk in so long a pause; the pause may become rather too long, and the ventricle too full for prompt recovery. Or the intermittence may be due to vagus protection, and significant of some need of nursing; in this case the rate will be retarded and the use of digitalis chancy, lest the interruption be a second too long. At the same time it is true that if a lengthened pause may facilitate a prolonged regurgitation, on the other hand, digitalis should be so raising the tone and constricting the left ventricle that this chamber should offer to the incoming blood a smaller cavity and a more reluctant wall. How far the aortic closure is supported by a muscular cushion is a point on which physiologists have not spoken decisively; but if there be such an action, digitalis ought to promote it. Bed with the use of strychnin may suffice for the time; then, while rest is still observed, digitalis may be administered cautiously under the eye of the physician. Never should we administer digitalis to such a patient as a matter of routine; its effects in aortic regurgitation must be observed day by day, and its doses rather momentary or periodic, not for continuity. On the other hand, a steady maintenance of diastolic pressures must promote good circulation, and digitalis may do this without trying the heart with much increase of systolic pressures. Moreover, we must not forget that

some acceleration of the pulse rate may be a condition of an adequate pressure head in the aorta, so that retardations might be dangerous. The effects of digitalis in the sound if maimed heart of aortic regurgitation due to past valvulitis in a young person can be no precise guide to its use in the case of adults, generally elderly persons, in whom this regurgitation has arisen from atheromatous decay; and this in an area where the coronary arteries are apt to be involved or to be themselves the seat of the same degeneration. In these cases its tentative use must be governed by our experience of it in atheromatous and otherwise degenerated hearts generally, with no inconsiderable additional element of caution in the presence of an aortic regurgitation—in which either the prolonged pause or an interference of the vagus may issue in sudden death.

However, to say that digitalis is of no service in aortic regurgitation is one thing; it is another to say that this occasional service may be bought too dear. Sudden death is a common issue of aortic insufficiency, and must not be too readily ascribed to whatsoever remedy or effort was in action at the moment; yet notwithstanding these deductions, and not forgetting that the percentage of heart cases under digitalis is very large, there remains in the memory of most physicians some few cases of sudden death during the use of this drug, to suggest that the association was frequently out of proportion to the whole number of sudden deaths in aortic regurgitation, or occurred in some disproportion during the stages of the disease when presumably death was not menacing. Babcock, however, in his interesting book not only recommends digitalis under the conditions here given, but has had reason sometimes to regret that he had not been bolder in the use of it. In these doubts the physician will not deny the patient the aid of digitalis and its congeners when atony of the left ventricle seems to require it; but he will refuse to do so unless the patient will retire to bed or couch, and submit himself to vigilant supervision while the drug is administered. The doses should be small and guarded with atropin or strychnin; for large doses act with disproportionate intensity upon the vagus; small doses confine their action more to the cardiac muscle (see p. 68).

When the heart is then in fair equilibrium and the patient in good general health, let us repeat, no medicine is needed; it is unwise, indeed, to keep a man with his eyes always directed to some flaw in his machinery; an altered habit of life is imperative, but with time this should organize itself subconsciously as "second nature." This second nature must contain also an order of diet, a diet so altered as to avert systemic rises of arterial pressure and atheroma. Such a patient should shun alcohol, be cautious with tobacco, and give preference to simple and not too highly nitrogenous foods, using them in small if more frequent meals. And he should regulate the amount of food strictly by the needs of the body, to which in most persons the scales are a good guide. It is to be remembered that he is not taking vigorous bodily exercise, and mental efforts—according to Professor Chittenden—expend less food. At the same time he must not by any means let down his general nutri-

tion, or that of the heart may suffer; and it is my habit to direct such patients to take from time to time courses of mild ferruginous tonics with gentle laxatives whereby to secure the best of blood for the cardiac arteries. Exercise is not to be altogether forgone. In a flat country the bicycle may be used, with the conditions of walking up inclines and never facing a high wind. In a well-compensated case golf may be played, if not in rivalry; or horse exercise taken on a quiet animal. Perhaps walking is the least risky of exercises; but we have in such cases to consider the health of the mind as a condition of that of the body, and for most people walking in familiar places is dull. I have never seen any harm from walking up small hills, if the effort be begun gradually, and the adaptation of the heart gently solicited in the first half-hour; then, as the muscular areas open out and pressures fall, the pace may be mended a little.

It is needless to say that methods must be adapted to the individual, or that the factor of age must be carefully weighed in each case; the prescriptions and regulations which would be appropriate to a substantially healthy young man with a moderate degree of aortic regurgitation, would be improper in an elderly man with evidence of vascular degeneration, even if in this case the insufficiency were still less. It is scarcely necessary to work out such discriminations at length, and the problems of atheroma of the coronary arteries are discussed elsewhere. Suffice it to say that the result of the test exercises (p. 66) and the observation of diastolic pressures will help us in estimating these individual factors, and that, beside the broader outlines of age and general health and vigor, there are in each one of us peculiarities which cannot be measured exactly, but will reveal themselves to the observant physician. The most significant symptom is substernal pain or oppression during movement—as on ascending slopes or stairs, even without dyspnea; especially if the pain travel down the left arm, a symptom significant of angina, which is very apt to supervene in aortic disease; but the treatment of this condition will be found in another chapter. The use of iodids in aortic regurgitation is considered under Arteriosclerosis and Angina Pectoris.

Combined Valvular Disease.—It is scarcely necessary, I think, to enter upon a detailed consideration of combined valvular diseases; as in the classic instance of Chinese Music, in which the reader was to look up China and music severally and then combine his information, so I must ask him to combine the directions given under the several valvular lesions. Seriously, I believe that the principles of treatment laid down under the several heads of valvular and myocardial diseases will be found in their respective degrees readily applicable to combined lesions, or with only that difficulty which I fear will long cloud our way in dealing with grave disease of the circulation. Combined lesions are obviously divisible into main classes, namely, those which originate independently, and those in which one lesion is consequent upon the precedence of another, as in mitral regurgitation secondary to aortic, or tricuspid stenosis consequent upon mitral. Still, during periods of disturbance in cases in

which the order of the several lesions is in their history obscure, we must often be content to work on lines of symptomatic treatment; at times when the functions are calmed and regulated it may be easier to read the pathology of the case more intimately.

THE OBESE HEART

In these cases the problem is how to alter the decadent tendency before it reaches a degree incompatible with life. If the patient be very stout the heart may be more impeded than incompetent; and we shall be confronted again with the question of intrinsic versus extrinsic failure, though in another form. If in these cases of obesity there generally is some notable element of intrinsic impairment, yet in them some renovation, much perhaps, is possible if external impediment can be removed. Recent researches indicate that the fiber may not have perished so much as we might suppose. No task is more delicate than the treatment of fat folk in whom the heart is fat, and getting too fat for efficiency. Moreover, physical appreciations are very difficult in these gross chests. Such people are usually large drinkers of fluid, alcoholic or not; and their hearts are dilated. In many of them arterial pressures are too high, or high feeding has done other evil work. To alter the conditions of an established, if abnormal, mode of the circulation when possible, is possible only by patient and gradual methods. When the adaptation of the patient to abnormal conditions is of long standing, and has brought about other adjustments of heart and vessels, restoration to the normal cannot be hoped for. The machine may be modified in the direction of the normal, but it cannot be remodelled; things are altered too far. And if, in so far as decay or strain of the muscle has set in, our prospects of success are the darker, yet if the failure be rather that of overlabor or sluggish vitality than of intimate disintegration, we are not without hope. The worst thing we can do is to put the patient suddenly upon a rigid diet—however correct in the abstract—to purge him and to sweat him, to arouse him and to drill him. Yet if the physician will bestow time and pains upon the case, some such measures may be established step by step. Little by little fluids will be moderated; little by little the obesity will be melted off, consumed by cautious exercises regulated to the individual and his varying states; little by little food will be reduced to the stricter needs of the body. For, generally speaking, a gross habit of body means overeating and drinking. Here and there no doubt we meet with persons who in spite of abstemious habits and regular exercise grow fat, and such persons are very difficult to relieve; but we are seldom far wrong when we guess that the fat man is consuming too much, or that the fat woman is too idle. In some of these people beer-drinking or an excessive consumption of sugars and starches may be the fault. The peril of this habit of body is as great in those who fatten too readily on excess, positive or relative, as in the gross feeders; indeed worse in so far as the way of cure is less direct.

Obese persons with obese hearts, if they be patient in disposition, caught in time, and willing to submit to present privation for future advantage, even if gravely ill, are by no means cases of despair. Generally speaking, if the first few weeks of privation can be surmounted, the patient no longer feels harassed by his self-denial; he begins to feel, on the contrary, lighter and better, and is surprised to find how much too high have been his notions of necessary food; his artificial appetite or craving diminishes, he is more active, and confidence in a tactful physician accelerates his cure. Notwithstanding, even at this stage also it behooves us not to go too fast. The heart is flabby and dilated, or, at any rate, too weak for so big a body; the adipose tissue has swathed the muscular wall about, and driven wedges into its substance, dissociating and weakening its fibers, and perchance dissolving some of them. Moreover, if the pressures are excessive, the systemic blood-vessels may be permanently stretched, and their walls may have undergone deterioration (see Arteriosclerosis, p. 155). If so, they cannot readily close down upon a smaller content of blood. We have to try so to redistribute their contents that the abdominal, pulmonary, and systemic areas shall receive their due proportions and no more. During this period of testing and watchfulness, a time the more anxious as, in the obese, physical examination is far from easy or conclusive, the patient must be placed under the simplest conditions for observation; that is, at comparative rest. Then, if the rate of the heart be accelerated, and its dimensions wide, we shall try cautiously with digitalis to contract them; if the arterial pressure be low, and the venous high, we shall endeavor by this and other cardiac tonics to reverse the order. But if the case be one of arterial hyperpiesis we shall proceed with even more deliberation; for under the stress of the high pressure the left ventricle may have become hypertrophied and dilated, and, indeed, the mitral orifice may have been forced; if so digitalis is indicated hand in hand with other means proper for the relief of excessive peripheral resistance. Many of the obese cases, however, are cases not of hyperpiesis but of increasing cardiac inefficiency, or relative inefficiency for the big body, at normal pressures.

If, thus feeling our way meticulously from point to point, we make a little progress, and think the time has come for a bolder course, we may betake ourselves to gentle exercises of resistance; and in comparatively young and sound persons we may get on from these even to the climbing (Oertel) method (p. 107). Perhaps under such conditions, if the state be of recent initiation and in a fairly sound subject, a complete cure may be hoped for; and in most cases cure may be carried very far. In cases of long standing, however, and in flabby or elderly persons, we must not be too ready to promise substantial or permanent amelioration; though a balance tolerable enough for a narrower life may be attained and preserved. Such a result is more probable in cases of venous than of arterial high pressure. In hyperpiesis, if inveterate, to reduce peripheral resistance to a workable mean, and to keep it there, is a hard task (p. 157).

Once more: In our stage of first tentatives we may find that the heart does not respond as we had desired; it flags, the chambers do not empty themselves; the pulse-rate is accelerated and yet digitalis does not nicely moderate it; or, what is worse, the rate is abnormally slow and we may apprehend that the organ is itself in dilapidation. Nutrition may be defective because the general nutrition of the patient has been bad, or because the coronary circulation is impaired; or, unhappily, both conditions may be present, and discrimination not easy. We may try to determine the state of the coronary arteries by inference from the state of the palpable arteries—the aorta, radial, brachial, and dorsalis pedis; but the inroads of atheroma in elderly persons are too capricious in distribution for very definite inferences on this basis. It is more material to remember that in cardiovascular disease associated with high arterial pressure, present or past, the heart will be enlarged, especially on the left side; and that the aorta may betray signs of atheromatous dilatation, and if so, that the coronary arteries or their orifices may be involved. Or if the arterial atheroma is not that consequent on arterial hyperpiesis, but a senile involution, the heart will not be evidently enlarged, unless there be aortic stenosis, in which case the aorta will not be dilated, and the arterial systolic pressures will be under 150 to 160. Our experience is, a primary cardiac decay does not usually concur with considerable arterial disease, probably because of the slow inroad of the atheroma and the progressive readaptations. Thus we may find ourselves saying, paradoxically, that treatment addressed to a failing heart is more likely to be successful when atheroma is present. Unmistakable signs of cardiac failure occurring in the presence of fairly normal arteries, and without evidence of high pressure, are more ominous, and are prone to end fatally before any long lapse of time. In these cases the heart is often not obviously altered in dimensions and the physical means of diagnosis are indecisive. The special treatment of such cases of primary failure is described in the next section.

HEART FAILURE

Under this vague title it may be convenient to consider the cardiac breakdowns which occur in some persons about middle life, at an age rather before that of the "senile heart." These cases are very difficult of explanation, and so are the more difficult to treat with any calculable results. Not infrequently, indeed, death is sudden, no complaint having indicated the perilous state of the center of the circulation. The marasmic heart of old age, and the heart undermined by atheroma will be alluded to in another section (p. 153). In the cases now contemplated these senile factors are not to be assumed, the cause lies in a myolysis, often of unknown origin. In other paragraphs I have speculated how many of these cases take their rise in a bygone infection; but—so far as the histories can decide—such an origin in most of the cases was not to be traced. Indeed, this kind of cardiac decay seems to be hereditary, and such a patient may tell us that "we all die of our hearts in our family before sixty years of age."

In most of these cases, I repeat, the dimensions of the heart are not notably altered; but in some of them the heart is dilated, and in these there are usually some anticipations of the threatening event; the ears get cyanosed, the breathing pursy, the bodily condition anemic and often adipose, the fat being due, perhaps, to a growing disinclination to bodily exertion. The principles of therapeutics as applied to dilated hearts scarcely apply to these cases. In the patients I have now in view an intimate decay of the cardiac muscle is suggested by their want of satisfactory response to the discretest methods. The close observer may detect in them a slight and chronic condition of Cheyne-Stokes respiration. This symptom, which may persist for weeks or months, is one test of our remedies. The "provocative" methods of treatment are ill borne. When the heart decays without definite change of cardiac sounds or area, diagnosis may be difficult indeed, and, until perhaps a mitral murmur appears, must be largely inferential. Cardiac aneurysm and rupture are prone to occur in these cases, but are, of course, as much beyond diagnosis as beyond treatment. Iron, strychnin, and other of the remedies of the kind, not forgetting climate, will be turned to such advantage as may be available.

Under this head may be included the syphilitic heart; that is, the invasion of the cardiac tunics and substance by gummatous growth. Syncopal bradycardia (Stokes-Adams) in a person under fifty years of age might suggest this process, and if there be any old story of syphilis, Wassermann's test should be employed, and if positive, a specific course of treatment tried. We are scarcely in a position to say with what hopes of success.

The degenerated heart of alcohol can only be dealt with to any effect—the palliatives are already sufficiently indicated elsewhere—by total abstinence from the poison. For the big and often enormous hearts not infrequently seen in beer-drinkers, total abstinence not only from alcohol but also from bibbing of any fluids in excess, and a prolonged obedience to the dietetic and medicinal methods for dilated heart may do much. I must admit that I do not remember a complete cure of any such case; nevertheless, there seems to be no sufficient reason to deny a patient such a hope if other things are favorable, and if—and this is probably the main difficulty—the patient not only gives us fair promises, but keeps them.

Cardiac dilatation secondary to emphysema and other pulmonary stresses, if the lung condition can be ameliorated, is more hopeful than that of beer-drinkers and the like; and needs, perhaps, no special discussion; the therapeutic means will include those appropriate to the state of the lungs, the relief of which will do good all round. Vigilance against bronchial irritation is of the first importance in all heart disease with rising venous pressures.

The only other kind of cardiac affection I need mention here is one of the most common, least fatal, and perhaps most amenable to our art; I refer to the "weak hearts" of some middle-aged persons, chiefly of women, but of men also. Some physicians have been too ready

to tell any woman who has a little palpitation, or finds herself a little out of training on ascents, that her "heart is weak," and that she must watch and nurse her heart; so that thereafter by excessive apprehension and loss of fresh air and exercise she is likely enough to do herself harm. On the other hand, it is certain that in some persons in later middle life the heart does become, as it were, flaccid, atonic, and unequal to any considerable demand. Like the more fatal kinds of cardiac disease touched upon in the last paragraph, the disposition to "weak heart" runs also in families. The sounds are thin and the rate easily accelerated. However, these hearts do not give way for a long time; ultimately a little albumin may appear in the urine, but it may be years before a mitral murmur makes itself heard, yet it usually comes in time. It is seldom, however, that the patient dies directly of the cardiac disease, the heart generally loses way under the stress of some acute affection, such especially as "bronchial chill" or "influenza." For some previous years such patients had not been able to walk easily up inclines; palpitations and dyspnea soon made themselves felt, and rests were required after social or domestic efforts. Of more immediate cardiac remedies, digitalis, which may be combined with iron, quinin, or with both, is very useful, even for weeks at a time; diuretin or caffein is also of occasional service. But for a continuance, gentle exercises expanding the lungs, mild ferruginous medicines with quinin, arsenic, or other such tonics, answer best on the whole, with bismuth for the digestion, very gentle laxatives, a regular rather protected life, and a meticulous nursing without coddling of catarrhal colds when they appear. An equable climate is most desirable in these cases if it can be managed, if only for opportunities of outdoor life.

There is no evidence that I am aware of to prove that these cases are due to intestinal toxins. A large number of fragmentary case histories seems to point to a constitutional habit of low arterial pressures which, so far from accumulating cardiac energy, tend—if only by low-pressure coronary circulation—to its deterioration. Such persons in earlier life "were never strong," they were subject to slow digestion, cold extremities, and sluggish bowels, and were incapable of endurance or exposure. Their pulmonary ventilation is poor. Such persons take tea to cheer and enliven them. In middle life they get languid and fat.

Senile Heart.—Without this title a section of Cardiac Disease would appear incomplete. Yet the heart grows old in many ways, and for my part I have no clear conception of senile heart as even an approximately uniform condition. The book with this title, by Dr. George Balfour, full of interest as it is, left me still without a clear view of any such disease; and, indeed, I do not suppose that by his title the accomplished author intended to signify such a conception, but to discuss a collection of heart diseases as they occur in old persons. In my experience, indeed, senile hearts have not in common even the element of muscular degeneration; on every post-mortem table hearts are taken from aged persons, and from persons who are the subjects of advanced arterial degeneration, which are either of good muscular

quality or contain sound fiber in plenty for the limited needs of the elderly (see Aortic Stenosis, p. 143). These hearts, like the bladders of old men, are often muscular enough, and fail not by inherent decay but by defeat in an unequal task. As I have said already, even their coronary sclerosis, if it come on slowly enough, is not necessarily or perhaps generally attended with muscular decay; the callous patches of fibrous tissue are probably of little importance within a range of narrow function. In skeletal muscles, at any rate, we know that for ordinary efforts not all the fibers are called into action, and the same is probably true of the heart also.

More characteristic of old age is the degeneration in Aschoff's tract manifested as "Stokes-Adams disease"; apart from toxic causes, such as syphilis, this disease does belong to old age; perhaps in nearly all elders some loss of conductivity is apt to come on in this way, and may be recognized by a quick observer by some foreshadows of the clinical type. And again "weak heart" and "atrophic heart" are modes of senile circulatory failure which are seen in two modes, especially on necropsy. The one is a "toneless mass," a flaccidity of the organ, which, however, is not much dilated, if at all; too little, at any rate, for definite demonstration during life. This loss of quality in the muscle has as yet evaded histologic and chemical research, as is the case also with strained cardiac muscle. The other is a marasmic condition known as "brown atrophy," a state in which the muscular value must be deteriorated, though we have recognized as yet no clinical features by which to determine a diagnosis of it. "Fatty heart," which occupied so large a part in the pathology of the last generation, and was so useful a phrase for superficial diagnosis, has lost some credit in pathology. Often it is, if not a post-mortem change, yet one which dates from no long antecedence; it is found time after time in bodies of persons of various ages in whom no cardiac failure had been apparent or suspected; and is often at any rate an accumulation of fatty particles upon the fibers rather than a fatty transformation of them.

On *diseases of the right side of the heart*, on *congenital deformities*, on the *morbus cæruleus*, and other minor disorders, special sections are not included, as in them the principles of treatment are the same and their application differs but little.

Diseases of the Arteries

Arteriosclerosis.—The difficulty of discussing the therapeutics of arteriosclerosis is on the threshold; what is that which we propose to treat? Arteriosclerosis is a name in pathology, not that of a morbid process; it is a result of morbid processes. Even in pathology this result is not uniform, but of more than one kind; and in clinical medicine the morbid processes which abut upon it are multiple. In this section, if I am to express my opinions clearly, I must use my own classification, and this is as follows: (*a*) Toxic arteriosclerosis, such as may follow syphilis, typhoid fever, and other infections, mostly at any rate of extrinsic

origin. (*b*) Senile arteriosclerosis, which may be the simple effects, especially on the elastic and muscular coats, of wear and tear, either in degree excessive or acting upon vessels naturally defective; or some morbid influence, such as an autochthonous perversion of metabolism, may prepare the vessels to wear out sooner. (*c*) Arteriosclerosis the consequence of prolonged excessive arterial blood-pressures, injuring the arteries by stretching them beyond their elastic limits, and too often, under the twofold condition of arterial damage and high pressure, ending life by rupture in the brain. For these several kinds of processes corresponding differences of treatment must be designed.

(*a*) The treatment of the arterial disease secondary to infection must in the first instance be that of the primary malady; the treatment of syphilitic arteriosclerosis is that of syphilis; of plumbism, that of plumbism; of diabetes and of typhoid that of their respective diseases, and so on. In case of any likely infection the physician must not fail to anticipate this possible deterioration, in order that while the patient remains under observation he may examine the arteries carefully, and mitigate its incidence so far as he can by extending the period of rest or care, and by warning the patient against too ready a resumption of bodily exertion. If at a later date the patient presents any signs of such change the treatment must proceed on the general line of a moderation of extremes of arterial pressures by dietetic restrictions, gentler exercises, and mental peace. Close attention is to be given to the excretions also, especially to that of the kidneys. I believe that the arterial thickenings in youth or adolescence consequent on non-syphilitic infections tend in time to disappear; for I have seen them not infrequently in young persons, and in some cases I know the vessels were restored to health. So good a result becomes less probable as the years of growth are left behind; and it may be that the not very rare cases of extensive arteriosclerosis met with in persons barely in their fifth decade may originate in a long-forgotten infection. Even in syphilitic arteriosclerosis under punctilious treatment I would not despair of recovery; for in a large number of cases of old syphilis there is not the arterial degeneration one might have anticipated; and symptoms of specific cerebral arteritis often disappear, not to return for the rest of a long life. For cases of old standing there is nothing specific to be done, scarcely even in the traces of old syphilis; the hand cannot be put back on the dial. It is very important, however, in all such cases to keep a register of the arterial pressures, in order that as little stress as possible may be permitted to fall upon the prematurely weakened tubes. Fortunately, in many of the cases of this class pressures are not abnormal. In plumbism, for instance, it is raised, in diabetes or syphilis it is not. With such ulterior consequences as gangrene we are not concerned in this part of the work.

(*b*) The senile or involutionary form of arteriosclerosis will not delay us long in respect of treatment, unfortunately, as this brevity is the expression of our ignorance. Of the little we know of the nature of the disease, practically nothing is available for therapeutics or prophylaxis.

While, on the one hand, we see involutionary arteriosclerosis very commonly in men whose lives have been given to bodily labor, at any rate in the limbs, on the other hand, it occurs no less commonly in persons of sedentary life, in women as well as in men. It is as common in the temperate, and even in the ascetic, as in the toper and the gormand. That tobacco is a cause of it is an assertion wholly without proof; the disease is frequent in women. We have to content ourselves, then, in cases in which we find reason to fear this degeneration may be at work, to advise the patient to avoid active games and other hard muscular exertions, and to pay scrupulous attention to the secretions, lest the disease be due to some unknown toxin generated in the bowel or elsewhere in the body. The disease is compatible with very long life; but the perils are two—the silting up of cerebral arterial twigs, or the intercurrence of a period of hyperpiesis to which these subjects are as liable, but not more liable, than other people. From time to time then, especially at any season of indisposition, we should satisfy ourselves that the arterial pressures are not rising, lest a rise of pressure should rupture a brittle vessel. It has been urged that we should eliminate lime from the dietary of such persons, which seems to me much the same thing as to deny a person ready money while leaving him his check-book. And perchance the lime may fortify the decaying vessel.

(*c*) With arteriosclerosis the result of hyperpiesis the matter assumes a different aspect. In a better world than this no such perilous condition would be permitted to sap the elastic strength of the vessels upon which mind and body depends, without a systematic campaign of prevention. In some persons, indeed, the causes of enhanced pressures are so persistent and subtle that no ordinary watchfulness detects the covert evil at work; or if discovered our measures of counteraction may prove unavailing. It may be that the processes of hyperpiesis are not one, perhaps not very closely akin, but several and heterogeneous; and one kind of treatment may not be equally applicable to all. In some cases the liver may be concerned, in another the kidney; we know how definitely rises of arterial pressure are due to chronic disease of the kidney. Hyperpiesis is, however, as I have said under Heart Strain (p. 131), by no means confined to renal disease; it occurs in no inconsiderable number of cases independently of what, clinically speaking, can be recognized as Bright's disease in any kind or degree; it is possible, of course, that in some obscure way the renal functions are implicated in the process, by way of some excretory defect, some internal influence on the economy, or absorption of some renal toxin, though so far the evidence is very slender. In any case it is of the utmost importance that while the pressures are rising the renal activities should be kept at their best, though the portal activities may be quite as important. After one day's constipation the pressure may rise and the heart begin to labor again. Renal disease is fully discussed in another part of this work, and we must not trench upon it here, but confine our attention to arterial disease the result of rising pressures which,

clinically speaking, are independent of Bright's disease. Arterial pressures may rise in young persons, even in children; but in them are for the most part dependent upon metabolic disorders which admit of ready relief; the vessels may thicken perceptibly, but probably in their muscle only. In youth the vessels are not easily stretched beyond elastic limits; and the disorder being of a more transient kind, and occurring at an age when recovery of the normal state of function is more prompt, it passes off before—so far as we know—any great harm is done; though, as I have said before, there are cases of premature arteriosclerosis in later years of obscure origin which may have taken their rise in some long, precursory infection or metabolic perversion. As middle life is attained, pressures rise, as a rule, say to 145–155 (systolic), a rise consistent with health; but in hyperpiesis they rise higher than this, and ultimately may attain heights almost or quite as excessive as in chronic nephritis. By these tensions the vascular system is strained no less irremediably, and the vessels are prone to break under the strain, especially in areas of feeble vasomotor resistance, as in the brain. Digitalis must, therefore, be reserved for stages in which dilatation of the heart is directly menacing; for it is too often by an attack of apoplexy that the long precurrence of excessive pressures is first revealed. It is, therefore, of the utmost importance that such tendencies should be controlled while there is yet time to prevent their injurious effects. When the stresses have continued so long as to have stretched the vessels considerably, restoration *ad integrum* is no longer possible; a compromise must be made, such as may keep the changes where they are, and ward off worse things. For this reason I urged at the Royal Institution, in 1905, that every man should have his blood-pressure taken at the age of forty-five, and, if normal, again five years later; but if it prove higher than is compatible with the time of life, the patient should be submitted to regimen and such medicinal means as should remove the bad habit. Unfortunately, to intimate to a middle-aged man that his pressures are rising, and to prescribe certain precautions, is apt to engender retrospection and even hypochondrial obsessions. Much rest is required. Speaking generally, no permanent harm is done by a hyperpiesis if of less than five years' standing; unless, perhaps, in very excessive cases, or conjoined with a proclivity to premature arterial degeneration; in any case, although the habit may usually at such a stage be averted, it will return unless continually prevented. In its initiatory stages it is not only more readily dissipated, but, with reasonable obedience to instructions, is often banished not to return.

If, on the other hand, the tendency has become habitual, it will need more industrious and solicitous treatment, and will return three or four times almost in spite of precautions; yet even then, if the arterial system has not been altered so far as to have got a new set, the rise of pressures, after being banished three or four times, may not return for some time, or may even be abolished; though it is to be remembered that after all treatment and regimen the original proclivity to the disorder may persist. If not themselves "gouty" in any appre-

ciable sense of the word, these persons often derive from a gouty stock. The causes being unknown to us, we do not know how or when the game is won; but even if the proclivity be inveterate much may be done, with the aid of periodic registration of pressures, to anticipate the disorder time after time; and in its incipient phases it should be cured.

What I may call the instinct of mankind from ancient times has led persons of this plethoric habit to certain remedies, such as venesection and spa waters. Although many of them—but by no means all—are of robust appearance, and may, indeed, perhaps by very virtue of high arterial pressures, be energetic and vigorous, yet they are conscious from time to time that all is not well with them. This discomfort is put down to "liver"—torpid or oppressed by free living; and it is supposed that a blue pill or two, or, in case of longer trouble, a pilgrimage to Carlsbad will put things back where they were. Then if a fit of apoplexy occurs!—well, it is the "act of God." Generally speaking, however, with due precautions apoplexy is preventable—sanguineous apoplexy, that is, as distinct from silting up of arteries, which is not the result of high pressures, but of involutionary arteriosclerosis, a process for which no antidote is known. Generally speaking, this does not occur till other senile changes have been obvious for some time. I feel little doubt that the systematic venesection of our forefathers was, if a somewhat blind, yet on the whole a beneficent observance, and not for habitual gluttons and sots only. How it acts for good is an enigma, and the cases in which for one reason or another it can be recommended may be few, but in these few I have found in it an invaluable means of relief. For example, six or eight years ago an intelligent lady consulted me for indefinite discomforts—vertigo, fulnesses, headache, depressions of spirits, etc. She was temperate in all things, but of gouty family, and her brother had recently died of apoplexy. I soon discovered that these symptoms arose from excessive arterial pressures, which by various means we tried to reduce, and not without some partial success; yet the case was an obstinate one, the arterial condition remained substantially unchanged. One day, however, I received from her a letter of gratitude, one of those letters which brighten our practice, saying that I had "cured her" by my advice and she had not felt so well for years. I had explained to her, as well as to her very intelligent family physician, that this was one of the cases for which venesection was appropriate. My hint had been taken, and hence the cheery letter. It is not often that we meet with a sufficient combination of intelligence and independence in physician and patient for this unpopular experiment. I have now ascertained that by occasional resort to venesection once or twice a year her health has been fairly well preserved for the last four years, and the heart has had a much better time of it. I have watched three or four other cases under periodical venesection, and am convinced of its good effects.

But for the present, at any rate, resort to watering-places will be a more acceptable alternative. A course at Marienbad, Carlsbad, or Harrowgate, or in milder cases, at Bath, Neuenahr, Royat, Aix les

Bains, etc., is of great value, and must be regulated from year to year by careful appreciations of the arterial pressures. If the case be undertaken, as we may trust will be more and more the case, in incipient phases, permanent cures will be achieved in those who will obey the orders of the physician as to diet and other matters of self-management. Where the case has gone too far for cure, the condition may be kept under to no slight degree; but unfortunately, as I have said, then we must be content with modifications; and in spite of all our care the heart may not escape defeat, or the cerebral vessels may give way. Of no disease is it more important *obstare principiis*.

Even in the days of Hippocraties these cases were perceived and a moderate and non-nitrogenous dieting prescribed for them.

But what of those who cannot go to spas, or who return to us between the summers; what can we do for them? The first order is great moderation in quantity of food, especially in respect of meat, which at most should never be eaten more than once daily, and then in small quantity. The diet should, however, be a mixed one—not "vegetarian," though plain and spare. Where fish can be had it may take the place of meat on two or three days of the week. When the "normal" weight of the patient is known, the scales should determine the amount of food. If he be obese the treatment described elsewhere in this work will be adopted. The subjects of hyperpiesis are indeed often thin, even meagre persons, yet such persons are often famous trenchermen and generous bibbers, who need régimen as strict as persons of grosser bodily habit. The classification of foods as purin containers and purin-free must be borne in mind, and the former eschewed so far as may be. It is a lesson of no less importance to order the means of keeping open the great muscular and cutaneous vascular area. Of this method I have already spoken. In incipient phases there is no practice so efficacious as to send these plethorics away on the hills for the day with but a crust of bread in their pockets. The appetite of the muscular tissue is increased and its katabolites seem, as we should expect, to promote vasodilatation.

But there is some evidence that vasoconstrictive toxins may be generated in the intestines. The urine should be carefully examined for indican or aromatic sulphates. Constipation must, as I have said, be anxiously avoided; though morning saline purges will not alone drive away hyperpiesis. A little sulphur, as in a lozenge or two, taken every afternoon, is an easy way of securing regularity of the bowels; and a larger alterative evacuation, by some preparation of mercury and salts, should be prescribed at intervals. Next to venesection there is no drug like calomel for these plethorics; to witness the relief felt on the use of a calomel pill even by delicate looking elderly persons of this habit, is often surprising. The pill is called for again and again, and always with the same happy result. I prefer, if well borne, to give $\frac{1}{4}$ gr. of calomel thrice daily for three or four days at appropriate intervals, but with some persons blue pills answer better. Salol and the like seem to be useless.

Under heart strain I have said that for the regular neutralization of high pressures the last drugs to be sought are the vasodilators, for to diminish these pressures, as to force down high temperatures, may be to embarrass the body the more. At the same time in seasons of dangerous tension it may seem to be the less evil of the two, and, if regarded as but a temporary resource, and by no means to supersede more radical methods, vasodilators may do considerable service. In the spasmodic dyspnea of high pressure nitrites must be promptly given. But if regularly employed they are often complained of by the patient, whom they "depress." On prolonged use the nitrites cause a discomfort due apparently to a slightly asphyxiative action, checking oxidation. The best way of tentatively administering nitrites is by a combination of sodium nitrite with bicarbonate of soda and nitrate of potash in a tumbler of water every morning.

Whether the iodids are efficient in reducing arterial pressures is an unsettled question. Some of my pupils, with the manometer, have obtained positive results, others have arrived at negative conclusions; and so far the negations prevail. The question is as yet unanswered. They may reduce the friction of the blood stream at the cost of the red corpuscles. Nevertheless, as the weight of empirical opinion is that, whatsoever experiment may decide, these salts have some beneficial effect in arterial disease, we may not neglect them. Dr. Martyn, of Bath, finds that the unpleasant effects of the iodids are averted by administration in the Bath waters, or no doubt, in other appropriate waters. An excess of base is desirable lest iodin be unpleasantly disengaged; so the medicine should not be given during digestion, nor near acids. Free dilution and rapid elimination are probably the favorable conditions. Unless in case of syphilis, 5-gr. doses, if continued for considerable periods of time, are probably sufficient.

Diaphoretics, promising as they seem, have proved in my hands of less service (see p. 100), unless in the form of bodily exercise as advised above. Turkish and other sweating baths with and without massage, if their effects can scarcely be without advantage, do not seem to show any marked success in practice. Pilocarpin is positively harmful, as it slackens the circulation by letting down the heart; moreover, it does no good, and need not be regretted. Thyroid extract sets up palpitation and disturbs the cardiac rhythm.

Diuretics, on the other hand, are valuable agents, though *ceteris paribus* high pressures make for aqueous diuresis, as one sees in chronic nephritis, or indeed, in any healthy person exposed to chill, as in changes of weather. On the other hand, we know by experiment that mere repletion of the renal vessels does not suffice for diuresis, and hyperpietic patients without Bright's disease are liable to periods of scanty lateritious urine, to be dealt with—indirectly, perhaps, for the most part—in the well-known ways. The urine must from time to time be spun for casts; hyaline casts are of little importance, but the granular kind, unless very rare, must be regarded with grave suspicion and the treatment calculated accordingly.

The "high-frequency electric current" is said to act in relief of excessive arterial pressure; and, although my experience of it is as yet very imperfect, in more than one case of the kind much benefit has followed it. Some further remarks upon the remedy will be found on p. 101. I may say likewise of the lactic bacillus (Bulgarian) tablets, which in this and the kindred disease of angina pectoris have seemed to me to be of considerable service. The direct method—six tablets a day—is better than the sour milk.

Angina Pectoris.—Terrible as is this disease, I regard it with more hope than do many of my colleagues. Distressing, agonizing as it is, its fatality partakes of the nature of an accident—the accident of an inhibition of a heart already prone to succumb under any stress or check. Even a healthy heart may, rarely it is true, succumb under the inhibition of an intense irritation of an afferent nerve. Many such cases are on record. One of my patients, a lady not more than thirty years of age, died under such inhibition in the agony of a gall-stone; at the autopsy the stone was found in the common duct; the heart and the rest of the body were found perfectly healthy. A decaying heart, although under comfortable circumstances it may carry on life for years, may yet be upset by an inhibition so violent as an attack of anginal pain may compass. The vagus nerve does not lose its inhibitory powers *pari passu* with degeneration of the cardiac muscle; it is, perhaps, the more sensitive to protect it at all hazards, even to kill it with kindness. In fact the diseased heart is found to be not less but more readily inhibited. In complete "heart block" the vagus may be prevented from reaching the ventricles; but in partial block its influence is still manifest and sometimes fatal. In young persons, however, when the heart is healthy—and angina is common enough in such persons, especially when attacked by acute aortic disease, as in syphilis, the issue of death is not so imminent, and in my experience has not occurred. With the subsidence of the causes the peril to life passes away. Yet even in the angina of young persons, and the more as age increases, it is necessary to protect the heart from inhibitive shock; and this is best attained by the continuous use of atropin. If atropin is said to raise blood-pressure somewhat, it is also said to dilate the coronary arteries. To every sufferer from angina I administer atropin systematically and imperatively, increasing the dose gradually as the system may be acquiring immunity. Besides its protective, the drug has also some sedative virtue.[1] Conversely, it is dangerous in an attack to apply smelling-salts or other keen peripheral irritations whereby the heart might be exposed to additional reflex inhibition.

If, as is frequently the case, the angina is associated with gout, we must counteract this constituent of it, whether by spa treatment or at home, by appropriate regimen and medicines, including colchicum, or by both methods; much will depend on the condition of the individual sufferer. In many cases the arterial pressures are abnormally high,

[1] I am told that the methyl-bromid of atropin is a better form of the drug; I have no experience of it.

and in all it is relatively too high—too high, that is, for the susceptibility of the suffering parts; so that in every case means must be taken to keep pressures down. Baths and exercises are, therefore, out of the question. If the attacks are frequent the patient should be advised to keep his bed, and injections of morphin with atropin may be imperative; but if the recurrence is infrequent it is difficult to propose such a counsel of perfection, one, moreover, which might otherwise entail some disadvantages. A serene habit of mind is a blessed aid in such maladies, for the principle of rest is much as it is in aneurysm. A course of the iodids should be ordered, and, even if the case be not syphilitic, the doses should be run up cautiously to considerable quantities. Lauder Brunton thinks no drug wards off angina pectoris so effectively as full doses of iodid of potassium. The salt should be largely diluted in water, or, as at Bath, in mineral water. Syphilis must from the first be carefully enquired for, and on any reasonable suspicion specific treatment vigorously instituted. I cannot too earnestly insist on this counsel. In cases where the salt is ill borne Tripier gives it per rectum. Every two or three days he increases the doses from 10 to 14 gr. in half a glass of water, and gives it in two clysters, night and morning. This he continues for a month; suspends it for a fortnight, and then repeats the course as often as seems desirable. Arsenic is credited, and justly in my opinion, with a postponing effect in angina pectoris; it is to be instituted in minute doses with meals, and gradually augmented to some 15 or 20 minims daily. It may be given as follows:

℞. Ferri arsenatis.....gr. $\frac{1}{8}$–$\frac{1}{4}$;
Quininæ valerianatis.....gr. i–ij;
Extracti nucis vomicæ.....gr. $\frac{1}{4}$;
Syrupi glucosi.....q. s.—M.
Et fiat pil. S.—One thrice daily.

℞. Liquoris arsenicalis ..... ♏iij–v;
Sodii iodidi..... gr. v;
Tincturæ belladonnæ..... ♏v–x;
Tinctura valerianæ ammoniatæ..... ♏xv;
Aquæ pimentæ.....q. s. f℥ij.
S.—Thrice daily after meals. (For continuous use in angina pectoris.)

℞. Liquoris arsenici hydrochlorici..... ♏iiss;
Liquoris strychninæ..... ♏iv;
Tincturæ digitalis..... ♏v;
Tinctuæ aurantii..... ♏xlv;
Aquæ florum aurantii.....ad. ℥j.—M.
S.—Thrice daily after meals. May be used for long periods in chronic cardiac weakness (Balfour).

The bromids also are useful, and, for continous use the bromid of strontium is to be preferred. Digitalis and its kind are, for obvious reasons, to be eschewed. The precautions in respect of the digestion (p. 118) are to be sedulously imposed and noted, for a windy stomach may, indeed, break the slender thread of life. Before as well

as after meals the patient must rest for at least half an hour; if convenience permit, in recumbency. Exercise must be restricted to gentle walking, and on the level only, for ascent of the gentlest incline may determine an attack. The rule as to exertion is that nothing is to be done which may produce an attack. Every seizure means a peg down in our progress. It is better, then, to take the air in a low easy carriage, Even mental occupation should be restricted to routine duties, and mental excitement jealously averted.

The means at our service more instantly to prevent the seizures are first, of course, the nitrites, which are supposed to act by their property of reducing the arterial pressure; this may be the explanation, it is so no doubt in part; nevertheless, it is not to be forgotten that the nitrites often relieve cardiac perturbations in which the pressures are low; the salts may have some sedative virtue imperfectly known to us. In the jaws of a seizure nitrite of amyl is to be inhaled from the broken capsule in the usual manner. This vapor is not so certainly efficacious as nitroglycerin, but in the majority of cases it answers well enough, and far more quickly. In some persons it acts unpleasantly and not so effectively; it may be that in them irritation of the mucous membrane (fifth and tenth nerve) causes a reflex rise of blood-pressure, or a reflex pressor effect through the vagus; such persons might try the drug by the mouth. Nitroglycerin acts in about ten minutes or a quarter of an hour, and is generally efficacious and well tolerated. Thus, for an attack of angina pectoris:

℞. Spiritus ammonii aromatici ..... ℥j;
Sodii bicarbonatis ..... gr. x;
Tincturæ cardomomi compositi ..... ℥j;
Spiritus chloroformi ..... ♏xx;
Solution of nitroglycerin (1 per cent.) ..... ♏i–ij;
Aquæ ..... ℥iss.—M.
S.—To be slowly sipped from beginning of attack (Powell).
To this I should add liq. atrop. sulph., ♏ss.

The patient is to be warned that its immediate effects may be attended with flushing and headache, but that these effects are harmless, and do not mean "determination of blood to the head." To keep up an open periphery, and so to reduce friction, the nitroglycerin must be given every two or three hours, and some increasing tolerance of the drug has to be reckoned with. But, unless the case be a severe one and prevention imperative, reduction of pressures during some considerable part of the day is probably sufficient or, at any rate, of much assistance. With us all, pressures are fluctuating widely from hour to hour, and it is found by experiment that to raise the aortic pressure considerably in an animal for short periods only will soon induce aortic lesions. So it may be presumed conversely that temporary reductions of pressures relieve a damaged vessel. Erythrol tetranitrate is more abiding in its reducing effect, and is a valuable drug, but its scope is diminished by its relative cost. For other means of reducing the tendency to high pressures, I must refer to the section on Arteriosclerosis (p. 155) and on Heart

Strain (p. 131), where also the lactic bacillus method is mentioned. Upon the strict physiologic life, open secretions, psychic tranquillity, so needful in these cases, I need not dwell at length.

In conclusion, I find it is necessary to add that success in treating angina pectoris, real or supposed, must depend on a correct diagnosis. Unfortunately, the minds of young practitioners, and not of these only, have been unsettled by the writings of those who into this class have thrown pell-mell all sorts of neurotic or toxic disorders, as well as some cardiac symptoms which resemble angina only in that they are attended with distress and more or less pain. It is said also, for the further discouragement of the physician, that a differential diagnosis of such maladies is, or in certain cases may be, very difficult. Now these patients seek many opinions, and as I have given some attention to the subject, my experience of the disease is thus fairly large; yet I do not hesitate to say that if the observer will clear his mind of all the confusing disputes about "anginaform pains," "vasomotor anginas," "pseudo-anginas," "tobacco anginas," and the rest of it, he will find no difficulty of differential diagnosis, or no more than in a few of the obscurer instances of any disease whatsoever. Such difficulty as may occasionally arise will be with those cases in which the symptoms are so incipient or so masked that for the time the data are insufficient; yet even in these a little patience and the application of modern means of diagnosis will soon justify a sure interpretation, and the proper treatment will present itself accordingly.

When we turn to the clinical side of the subject we do not find much more light. In not a few instances we are apt to diagnose, and if we are young physicians we confidently diagnose, "fatty heart" in elderly patients who prove afterward to have been no more than fagged and anemic, and who recover to enjoy many a year more of usefulness; or who prove to be suffering in an incipient stage of some other disease, such as diabetes or cancer.

Not a few "senile hearts" are, in my opinion, not diseased heart, but diseased medulla oblongata; arteriosclerosis of the vessels of this center leading to disorders of a heart which, if properly driven, might have lasted many years longer. Digitalis only adds to their embarrassment; strophanthus regularly and strychnin occasionally are more efficacious. I think with these reflections I may forbear from adding to therapeutic discussions, which I hope are all to be found in this section distributed in their respective places.

Syncopal Bradycardia.—For this disease little can be done except by those general means which lighten the burden indirectly; such means are appreciable only in the individual cases, and do not lend themselves to abstract description. Specifically speaking, the first consideration must be whether a syphilitic taint be possible; the occurrence of the disease in a comparatively young person would give point to such a suspicion, and one of the complement tests should be employed. In an elderly person presenting signs of vascular degeneration syphilis would scarcely be concerned, or if it had been, although the specific

treatment might be pursued for a time, yet disease of long standing would so surely have terminated in secondary irremediable destruction of a non-specific kind that we could not hope much from its intervention. If the arterial pressures seem not only of very high systolic value but also to be strongly sustained, some reduction of arterial pressures may be considered. For example, in one such patient, who presented the characteristic symptoms saliently, no little relief followed the not infrequent nose bleedings to which as an arteriosclerotic he had become subject. These patients suffer not only from giddiness but also from headache; but this is not rebellious to cachets of phenacetin and caffein. A general tonic containing strychnin—syrup of iron, quinin, and strychnin—is helpful, and it must not be forgotten that a few cases, probably due to some temporary oppression by a toxin, have ended in recovery. I have seen one case of such a recovery, probably two. For the seizures little can be done besides the ordinary attentions proper to syncope, unless life seems imperiled, when artificial respiration should be used to promote the movement of the blood in the cardiac chambers. Hot applications should be made to the heart, and some massage or friction over the same area can do no harm, and may be of some service. The subcutaneous injection of strychnin may promote the conductivity of the cardiac muscle. Some physicians, such as Dr. Robert Simon of Paris, have found atropin effective, others have been less fortunate. Nitrites do no good; the thyroid extract, from which something was expected, proved to be impotent to restore conductivity in a case in which Drs. Hay and Moore took careful tracings. Subcutaneous doses of camphor may be tried, and the physician will order alcohol and diffusible stimulants at his discretion.

Aneurysm of the Aorta.—Unhappily on this subject there is little to say, this little being rest in bed. We cannot deny that the administration of the iodids may contribute to the amelioration, if such there be, but the common condition of all the alleged aneurysm cures has been imperatively rest in bed; and for my own part, I think that it is by this condition that we attain to whatsoever relief we manage to compass. Whether we add a course of iodid of potassium, or of ergot (v. Schrötter), insist on a Tufnell diet, or attempt any one of the many surgical means recommended to us from time to time, we shall find that the rest in bed is the essential condition of success. As to diet, to press this to Tufnell's extent is unnecessary; Tufnell enforced this abstinence at a time when the values of diet were less well understood. If a man is to lie in bed for weeks and months at a time, his expenditure, whether for work or heat, is almost nothing, and his diet must be meagre. Such adaptations we now recognize better than we did, and it is not necessary to tease a patient in bed for aneurysm with more than this due adaptation of fuel to work. If we supply more than is wanted we shall load the circulation and undo the good which the recumbency was to secure. This restriction of diet applies as much to liquid as to food; if we add to the mass of the blood we shall add to the load the heart and vessels have to lift. Liquids, therefore, must be kept down, not to a rigid al-

lowance, but to the least sum which the patient can comfortably submit to. As I have already said, thirst is very much a matter of habit, especially if salt be sparingly taken. By rest, with its corresponding restrictions in other respects, a remarkable reduction in the symptoms and signs of aneurysm can be effected. The pulsation is moderated, the pains are mitigated, the pressures are reduced; but that even a long rest can bring about a cure is a dream. But by the rest the progress of the disease is delayed; the extensions which, if left to themselves, would soon destroy life, are abated, but not arrested. The patient rises after three or six months in bed in a much better condition, apparently at any rate, than he was before his recumbency; but even if on return to modern activity the pulsations and pressures do not reassert themselves, that these extensions are not stopped we may learn with a shock if within a year or eighteen months the patient dies suddenly of a perforation. The rewards for the enforced inactivity are the temporary solace of it, the moral restoration of a patient who can comprehend the principles of the method and may, no doubt, gain considerably by it, the relief of neuralgic and spasmodic sufferings, and probably sudden and less painful death, for after the recumbent treatment the acuter sufferings generally subside more or less permanently. Broadbent thinks that the iodids at least relieve the neuralgias of pressure; that they do so more effectively than the rest which is a condition of their use, I am not assured, though I would willingly believe it. I do not know that the iodids are of any special advantage in the aneurysms which originate in syphilis, though, of course, they are indicated for any side symptoms deriving from such a source.

None of the various ingenious surgical methods which have been proposed for the cure of aneurysm has made good a claim to serious consideration. If the physician and the patient together decide to try any one of them it must be on the definite ground of experiment. For my own part, I have tried electric methods to despair; and I have witnessed wirings, scarifications, and gelatin injections, not without mishaps, but without any evidence of virtues which were not attainable more simply by the obligatory rest which they entailed. In my own cases, then, I advise rest for four or six months, rest absolutely in bed, including the use of the bed-pan. It is most important that there be no strain at stool, and that to avert this a gentle laxative, such as sulphur confection, be administered as occasion may indicate. An evacuation of the bowels if it is not ready and easy must be abandoned at once. In case of accumulation in the rectum, oil, glycerin, or soap and water, perhaps with manipulation, will get rid of it. For the first week or two it is desirable to give 5 grains of a bromid salt three times a day to alleviate the sense of restlessness, which after a short time abates. The many means of dissipating tedium and inconvenience which are furnished for the sick bed will be provided. Before taking to bed the patient should, if possible, clear up all matters of business likely to make claims on his attention, so that he may approach as near the state of a vegetable as possible; and it is better even for his friends to scheme out the course

of diet and amusement beforehand, rather than have to appeal to his decision or invention while under the treatment. I also administer, if it is well tolerated, iodid of potassium because of the advocacy of physicians like Balfour and Broadbent, who may be right in urging its use; but I give it up without much disappointment if the patient dislikes it. For laryngeal spasm and for severe and enduring pain morphin hypodermically is inevitable. Dyspeptic attacks are apt to occur, especially at first before the details of the regimen are fully adjusted; they are best treated by a little starvation. Aneurysm of the heart or aortic sinus is practically never diagnosed during life, and as nothing can be done for the patient, it is perhaps better that his disease should remain unknown.

THE SURGERY OF THE HEART

By Clinton T. Dent, Esq., M. C., F. R. C. S.

Paracentesis of the pericardium appears at first sight to be an extremely simple proceeding. Nevertheless, the attempt to draw off fluid from the pericardial sac, even when there is a large collection, often fails and occasionally entails serious consequences. Thus the pleura, the lung, the diaphragm, or the heart may be wounded; the internal mammary artery or one of its accompanying veins may be punctured, and a sac that contained only serous effusion converted into one full of blood.

It is worth while, therefore, to consider the anatomic and pathologic conditions a little in detail. The area of precordial dulness corresponds to the portion of the anterior surface of the pericardium that is not overlapped by the lungs. Anatomically, the shape and extent of this area is far from constant, the main difference being due to the varying depth of the so-called cardiac notch in the anterior border of the left lung. There is no need to set forth here the size and shape of the area according to the canons of academic anatomy; for practical purposes it is sufficient to note that the fourth intercostal space, from the margin of the sternum to a line drawn through the fourth and fifth costochondral articulations, is wholly uncovered by the lung. A varying amount of the fifth space is similarly uncovered. The fourth interchondral space is wider than the fifth, and if the sternum is short the fifth space may be very narrow indeed. On the right side of the sternum it may often be possible to introduce a fine trocar into the pericardial sac, without wounding the lung, through the fifth or sixth interchondral spaces, provided the puncture is made close to the sternum.

But though the lung may escape, the pleura on the left side lies, in life, so close to the middle line that unless the puncture is made close to the sternum it is almost certain to be wounded. The area of precordial dulness corresponds to the portion of the pericardium uncovered by lung, not by pleura. The pericardial sac may also be reached by a puncture at the apex of the notch between the ensiform process and the seventh costal cartilage.

The heart is, it must be remembered, firmly anchored in its physiologic position, and it is most important to note that the heart is not displaced backward by even a very large collection of pericardial fluid. A horizontal section of the chest made at the level of the interval, in front, between the fifth and sixth ribs, shows that the cavity of the pericardium is of horseshoe shape. Roughly, the middle third of the cavity lies anterior and is thus accessible. If fluid collects in the cavity the distention takes place in the right and left thirds. The separation between the visceral and parietal layers over the middle third is very little altered,

no matter how great the amount of effusion, a condition that furnishes a ready explanation of the failure of paracentesis in many instances.

The internal mammary artery runs parallel with the sternum—1 to 2 cm. from the margin. At the lower part there are two veins accompanying the artery. Under an anesthetic or when there is dyspnea the veins would be distended.

Various situations have been recommended for the puncture. "Intramammary" puncture—that is, on the inner side of the internal mammary artery—may be made as close as possible to the sternum in the third, fourth, fifth, or sixth spaces. All these points are open to the same objection—viz., that the layer of fluid is likely to be shallow, and that it is, therefore, difficult to introduce the trocar and cannula properly into the cavity. The fourth interspace is the best. "Extramammary" puncture may be made 4 to 6 cm. from the margin of the sternum either in the fourth or fifth intercostal spaces. Generally speaking, the former of the two is the best to select. Every case, however, ought to be dealt with on its own merits. Seeing that there is so much diversity of opinion as regards the best site for puncture, it is certain that there is no ideal spot to select. A simple trocar and cannula is the best instrument to employ. The skin should be incised. If the skin is drawn down a little before the incision is made and kept down while the trocar is being introduced, the minute cut in the skin subsequently will not lie directly over the deeper puncture, which is an advantage. Delicacy of touch is required to introduce the point well into the cavity. A thickened pericardium may be pushed inward, even by a sharp-pointed instrument. A sudden stab may wound the heart. The direction of the puncture should be at a right angle to the plane of the chest wall, but as soon as the end of the cannula is within the sac, it should be directed toward the left. If the operator keeps his sense of touch well on the alert, he will realize at once if the point of the trocar is against the heart. It is essential that the fluid—especially if abundant—should be drawn off very slowly.

If the puncture fails, and yet there is strong evidence of the presence of fluid, it is best to cut down, as in dealing with purulent effusions. The withdrawal of even a small amount of serous effusion may give great relief. A second or third paracentesis may occasionally be necessary; but if fluid re-collects it will probably be best to make a free opening. Indeed, it appears to the writer that incision, with subsequent dissection down to the pericardial sac, ought to be far more frequently employed in non-purulent effusions. It is really a safer proceeding and far more likely to succeed than puncture. When the effusion is undoubtedly purulent there can be no question as to the surgical treatment. If puncture has been practised, and there is any suspicion of pus in the fluid withdrawn, trouble is certain to follow in the track of the puncture, and this may have traversed the pleura or lung. Free incision and drainage are then imperatively demanded. An incision along the fifth costal cartilage may be made or a flap reflected outward so as to expose the fourth, fifth, and sixth cartilages. Portions of these cartilages may be removed. The internal mammary vessels are then exposed, and may be either drawn inward or ligatured and

divided. Some recommend removal of a portion of the sternum. Probably this is unnecessary, and it prolongs the operation. The cartilages can be cut cleanly with a knife, but in removing any part of the sternum the chisel would have to be used. Rydygier advises making a triangular flap consisting of skin, muscles, and bone, or, rather, cartilage; the flap to be reflected entire. By keeping close to the under surface the pleura and pericardium can be safely avoided.

Chloroform is the best anesthetic to employ. It is undesirable to wash out the cavity. After operation the prone position has been advised, but drainage will be as efficient and the patient more comfortable if he is well raised in a sitting position. Extremely gratifying results have followed free drainage in purulent pericarditis; thus Kobert collected 35 cases with 43 per cent. of recoveries.

Treatment of Pericardial Adhesions. Cardiolysis.—Under the rather misleading term of cardiolysis, Brauer[1] devised an operation designed to relieve the embarrassment of the heart's action and the secondary changes in the heart consequent on pericarditis. The operation is especially indicated when, as a result of associated mediastinitis, the pericardium is adherent to the chest-wall.

The technic is simple. A semicircular or rectangular flap comprising all the tissues down to the costal cartilages, preferably hinged externally, is dissected up. The great pectoral muscle should be separated in the direction of its fibers. The flap may be made of a size to include the left half of the sternum and fourth and fifth costal cartilages. Freer removal has been practised, and the portions of the third and sixth costal cartilages have also been removed, as well as contiguous portions of the corresponding ribs. The amount of cartilage and bone actually to be taken away would depend on the nature of the case. Removal of any portion of the sternum appears unnecessary. The portion of the chest-wall to be removed is that which moves chiefly with the heart. The superficial perichondrium and periosteum may be removed, but there is difference of opinion as to the advisability of removing the whole of these membranes. As the object of the operation is to provide a soft-yielding chest-wall over the heart instead of a rigid framework, it has been argued that the operation is incomplete if any periosteum is left, for regeneration of bone may take place. But the cartilage will not be re-formed, and when the tissues are matted together the attempt to remove the deep periosteum would involve tedious dissection, lead to hemorrhage, and probably result in wounding the pleura or lung. The pericardial cavity is not opened, and, indeed, in a chronic case the cavity would probably be entirely obliterated. The operation is a thoroughly scientific one and merits more attention than it has as yet met with. Comparatively few records of this operation have been published, but suitable cases are not of frequent occurrence.

A general anesthetic can be given without serious risk when the myocardium is not much affected. Grave changes in the myocardium contraindicate the operation, and in conditions such as calcification it would, of course, be useless.

[1] Archiv f. klin. Chir., v. Langenbeck, 1903, p. 258.

SURGICAL TREATMENT OF THORACIC ANEURYSM

Little advance has been made in recent years in the treatment of thoracic aneurysm (limiting the term, for present purposes, to aneurysms of the arch of the aorta and of the great vessels springing immediately from it) by ligature of vessels. By this, as by the other methods to be mentioned presently, relief is at times afforded; but the cases in which "cure" is even claimed are very few, and in most of these the term is really inapplicable. Improved surgical technic has not mended and cannot appreciably mend matters. The grave septic troubles that occasionally, in former times, followed operations are now, it is true, extremely unlikely to occur; but the disease is really unaffected by the ligature of vessels in most cases, while in some the effect of the operation is the reverse of beneficial.

Necessarily, in aneurysm of the arch the distal ligature is alone applicable. In aneurysm of the first part of the aorta, ligature of the right common carotid and subclavian, if it brings about improvement, can do so only by extension of the clot down the occluded vessels into the aneurysmal dilatation of the arch. At the best this will be but a red, "passive" clot. An aneurysm in a limb is not "cured" until the sac is entirely obliterated and shrunken, and the vessel from which it springs occluded. Such a result, of course, cannot occur in the aorta; and in this sense aneurysm of the aorta cannot be cured by ligature. Sufficient passive clot may, indeed, collect so as to act as a pad and to prevent further dilatation of the aorta from the impulse of the blood, but this is no cure. Mr. Heath's well-known case probably represents as good a result as is likely to be obtained. The patient was supposed to have a purely innominate aneurysm. Double distal ligature was performed and the woman survived for four and a half years; but after death the aneurysm was found to be a bilocular one of the aorta, and the innominate was scarcely affected. In this patient the symptom of dyspnea—which was a very prominent one—was relieved greatly by the operation. The tumor also diminished in size, but it never ceased to pulsate and ultimately proved fatal by rupture.

In a case recorded by Mr. Barwell, in which the aneurysm was clearly aortic, distal ligature of the left carotid alone led to improvement. The patient died four months later from disease of liver and kidney.

Mr. Holmes says of a patient on whom the same operation was performed that "the man was greatly improved. Five years after the operation he was alive and tolerably well, though the aneurysm was not cured." Of 20 cases tabulated by Mr. Holmes, in which purely aortic aneurysm was diagnosed and double distal ligature performed, death took place in 13 at varying periods after the operation, which had evidently no good effect. In one a practical cure was claimed, for the aneurysm consolidated and the symptoms were relieved. This patient died three and a half years after, with pleurisy.

Stimson's case was well more than a year and a half after operation and markedly improved.

In 3 of Mr. Barwell's cases—in 2 of which the writer saw the oper-

ation performed—cure was claimed. One of these patients died of bronchitis three months, and the other of the same disorder two years, after operation.

In Langley Browne's case improvement was reported, but the issue is not stated.

In Rossi's case, in which the operation was performed in 1843, no result is given.

The cases mentioned were published some years ago, but in more recent times the results show no better success. There appears to have been a not unnatural disinclination among surgeons to perform—or, at any rate, to record cases of—distal ligature for aortic or aorto-innominate aneurysm.

No doubt in many of these cases the aorta was affected as well as the innominate. The records of the cases in which pure aortic aneurysm was diagnosed and the same operation performed, show, as might be expected, less favorable results. Mr. Wardrop laid it down as a rule that when aneurysm affects the root of the carotid, the swelling will present itself first in the little space between the two heads of the sterno-mastoid muscle. When the innominate is diseased the swelling will be found, generally, on the inner, and when the subclavian is affected, on the outer, side of the muscle. If the disease is seen in the early stage the symptom is well worth noting, but it is not one on which too much reliance should be placed. *X*-ray examination assists materially in the diagnosis, and if the appearances are such as to warrant the belief that the aneurysm affects only the innominate, the operation can be performed with rather more prospect of relief. The *x*-rays, however, will only show dilatation. They will not show the extent of disease likely to lead to further dilatation; and this is highly important. For, if the transverse part of the aorta is affected and softened, double distal ligature may lead to a very rapid increase of the aneurysm toward the left side. The whole force of the blood stream, unable to pass up the occluded innominate artery, is directed against the weakened portion of the arch. In a case seen lately by the writer, in which the tumor appeared to affect principally the innominate and first portion of the arch, double distal ligature was followed by an extremely rapid increase of the tumor toward the left side, and it was difficult to believe that this was not directly due to the operation.

In purely innominate aneurysm ligature of the vessel on the proximal side has been performed. Ballance[1] records a case in which the upper part of the innominate was affected. The tumor ceased abruptly a little distance from the aorta, so that ½ inch of comparatively healthy innominate artery intervened between the aorta and the tumor. The manubrium was divided, and it was found necessary also to remove ½ inch of bone on each side of the vertical incision. The artery was successfully tied. The common carotid was found to be distended with clot. The patient died the next evening from left hemiplegia, and death was due to extension of the thrombosis from the aneurysm to the middle cerebral artery. In all probability the thrombosis was not

[1] Lancet, Nov. 1, 1902.

directly referable to the ligature, but due to the general condition of the patient; for after ligature of the common carotid artery the clotting on the distal side does not usually extend far.

To sum up: ligature of the large vessels may under specially favorable conditions lead to improvement and the relief of symptoms; but it is almost impossible to predict whether such conditions are present. It is said by some that aneurysms of syphilitic origin are more favorable than others. Aneurysm commencing suddenly, especially if traceable to exertion, is more likely to be benefited by operation than one arising gradually and without mechanical cause. The more localized and sacculated the aneurysm, the more chance is there of firm coagulation and subsequent organization of the thrombus. There is, however, always a risk that the aorta may be softened even when not dilated beyond the actual tumor, and in such cases the operation is likely to do more harm than good. Secondary hemorrhage after ligature is now an unlikely occurrence, but even in the older cases this did not prove to be the most serious source of danger. The usual cause of death has been the direct progress of the disease uninfluenced by the operation.

The treatment by gelatin injections has now had a fair trial, but it has scarcely been successful enough to warrant the belief that it is a remedy of any great value. The idea of the method is to increase the coagulability of the blood. It is obvious that this is not a very direct method of treatment; 2½ per cent. solutions are recommended; 3 or 4 ounces, at a temperature of about 38° C., may be injected into the subcutaneous tissue of the thigh or the flank daily for three or four days. Injections of gelatin in the neighborhood of the aneurysm have also been tried, but there is no advantage in this method. In some cases, when the remedy was first adopted, tetanus followed; a calamity which is avoidable if the gelatin is properly sterilized.

Lancereaux says that the treatment is absolutely without danger, but 2 of his cases died suddenly from syncope. He employed gelatin solution 1.2:100 mixed with sodium chlorid solution of 7:1000. These solutions were sterilized in steam of 115° C. for thirty minutes.

As usual, when a new remedy is first introduced the results of its employment are spoken of in a spirit of optimism which further experience too often does not bear out. Experience of the method at the Johns Hopkins Hospital has not been successful. It appears to the writer that the results hitherto obtained show so little success that the method is not likely to be employed in the future; though in so desperate a disorder the patient may be given a chance of relief by a method which is certainly less dangerous than some that have been adopted.

Of the methods that endeavor to deal directly with the sac contents Professor MacEwen's treatment by acupuncture is probably the best, and in the opinion of so impartial and sound a judge as Mr. Jacobson merits more attention than it has hitherto received. MacEwen aims at irritating the wall of the aneurysm on the inner surface sufficiently to set up reparative exudation in the parietes. This irritation is set up at as many points as possible, so as to produce numerous white thrombi. A specially made pin is introduced into the sac and passed through its

cavity until it comes in contact with the opposite side. The pin is then moved over the surface of the inner wall so as to irritate its surface. The point of the pin just touches the inner surface of the sac and no more. The blood current may move the pin to and fro, or, if the wall of the aneurysm is too thick for this to take place, the pin may be moved to and fro so as slightly to scrape the wall. A single puncture may enable the operator so to touch a large portion of the sac wall. Several pins may be introduced or one pin may be introduced at various points. The pin can be left within the sac for several hours, but never for more than forty-eight hours. The results of this treatment, not only in the hands of Professor MacEwen but in those of others, have been encouraging. White thrombus has been formed and very great improvement has been effected. It is obvious that very careful choice of cases must be made; the method should not be rejected simply because in unsuitable cases it meets with no success.

It only remains now to notice the method of treatment by the introduction of foreign bodies into the sac. The best of these, known by the names of Corradi-Moore, consists in the introduction of fine silver wire combined with the electric current. Here again the method has the cardinal defect—as pointed out by Mr. Holmes—that it acts by causing "passive" coagulation of blood. The coagulum may disappear again or trouble may result from a too sudden clotting of the blood. In some cases the injury to the wall of the aneurysm by the current has led to subsequent hemorrhage. The method is a highly dangerous one; in a few cases it has led to successful results, but in most instances it has failed and in a large number it has done more harm than good.

It should be noted that in fusiform aneurysm neither this nor, for that matter, any one plan of surgical treatment is likely to be of benefit. A single case may be quoted as an instance of the risks that are run and the details that may be recommended. In a case of aneurysm of the thoracic aorta of traumatic origin, described by De Forest Willard,[1] a vulcanite canula with a steel trocar was introduced into the fourth intercostal space. The author considers that a veterinary hypodermic needle properly insulated would answer better. The withdrawal of the trocar was followed by serious hemorrhage, the blood spouting 3 feet into the air. Silver wire was found to answer best. Gold wire was not sufficiently rigid. Some 20 feet of wire were introduced and the current, commencing at 5 milliampères, was gradually increased up to 80. A less strong current is recommended. Careful precautions were taken against burning the sac walls or the overlying tissues. The patient left the hospital nine weeks later, against advice, improved. Numerous other cases are mentioned in the paper. The author concludes that in one-half of the cases so treated life was certainly lengthened, while all who survived the operation—a considerable reservation—were rendered vastly more comfortable. Very similar terms are employed by those who favor one or other of the methods already mentioned in recording their experiences of the plan of treatment they advocate respectively.

[1] Annals of Surgery, vol. xxxiv, p. 143.

INFECTIOUS DISEASES

TYPHOID FEVER

By Rufus I. Cole, M. D.

Typhoid fever is a general infection caused by Bacillus typhosus. This organism was first described in 1880 by Eberth, who discovered its presence in sections made from the internal organs of persons dead from this disease. It remained for Gaffky, however, to obtain it in pure culture, and definitely to establish its rôle by its cultivation from all cases, and by the demonstration of its relation to the pathologic lesions. This organism is not only found in the mesenteric glands, spleen, bone-marrow, and bile of persons dead from this disease, but it is usually found in many of the other organs as well, and in many cases it may be isolated from the blood during life. The present conception of the disease is that in all cases it is a general infection. The lesions of the disease are due directly to the action of this organism or of its toxins. The portal of invasion is probably always in the gastro-intestinal tract, probably in the small intestine, though certain writers have suggested that the tonsils may in many cases represent the portal of entry. There is no evidence at present for believing that the intestinal lesions may be induced by the growth of the bacteria while free in the intestinal canal. Through slight abrasions in the intestinal mucous membrane or in some other manner, at present unknown, the bacteria invade the structures in the intestinal wall. The lymphatic tissues are mainly involved, and there occurs swelling and later ulceration of the lymphatic structures known as Peyer's and solitary glands. The mesenteric glands are quickly invaded, and from these the bacteria are carried into the general circulation and to far distant parts of the body.

While the isolation of toxins set free by the growth and multiplication of the bacteria has not yet been accomplished, it is thought that through the intervention of these hypothetic toxins parenchymatous changes are induced in various of the internal organs, including the heart and nervous system, and in this way the symptoms of the disease are largely induced. In addition to the more widely distributed lesions, local, inflammatory or suppurative lesions may occur. From these the bacilli can usually be isolated in pure culture, and the lesions are probably induced by the localization here of bacteria which have been transported through the blood stream. Whether such local lesions

may be induced by Bacillus typhosus without the latter having first produced any lesions at the portal of entry, and without having given rise to the clinical entity (however atypic) known as typhoid fever, is at present unsettled. Also whether typhoid bacilli may invade the body and produce all the symptoms of the disease without first having given rise to intestinal lesions is not fully determined. Apparently a few such cases are known, but they are very rare. The typhoid bacilli can undoubtedly remain quiescent in the body for a long time after recovery from typhoid fever, being present in the bone-marrow, bile, or elsewhere, and then later give rise to a local infection or to one of the sequels of this disease. It has also been shown that all the clinical features considered characteristic of this disease may be induced by another organism or other group of organisms spoken of as paratyphoid bacilli or paracolon bacilli. These organisms are very closely related, both in morphologic and cultural characteristics to Bacillus typhosus. While the pathologic features probably differ slightly from those induced by Bacillus typhosus, the two conditions cannot be differentiated by clinical features alone, and the treatment is the same in each case; so for the present at least this condition should be considered simply as a variety of typhoid fever.

Typhoid fever is a widespread disease. Its occurrence has been reported in almost all countries explored by civilized man. In most parts of the United States the disease is endemic. The incidence in different localities varies very largely, however, and seems directly dependent upon the hygienic conditions prevailing in the locality, to the greatest extent upon the purity of the water supply. Besides the widespread endemic occurrence of the disease, epidemics of varying grades of intensity occur from time to time. These epidemics can frequently be traced to pollution of the water or milk or of other articles of food. The continuation of the epidemics and the endemic occurrence of the disease, on the other hand, seem to be largely dependent upon direct infection from one patient to another, through the transference of the bacteria from the stools or urine of the one sick to the fingers or food of the person attacked. It has lately been shown that flies play an important rôle in this spreading of the disease.

The disease is most prevalent during the late summer and autumn months, though it may occur at any time. It may occur at any age, though young adults are most susceptible. Whereas in many acute infectious diseases the weak and infirm are most likely to be attacked, in typhoid fever it is not so, but apparently the strongest and most robust are equally susceptible.

The course of the disease in different individuals and also in different epidemics varies remarkably, both in intensity and character. It may last only a few days and be associated with very little or no fever or, on the other hand, there may be a continuous fever of great intensity, lasting from six to twelve weeks or even longer. Associated with the fever there is usually a rose-colored eruption over the abdomen and chest and frequently enlargement of the spleen. In addition there occur

various other symptoms referable to the local lesions induced by the typhoid bacillus and to the effects of the hypothetic toxin. Owing to the manifold manifestations of this disease (which seem to have no relation to the age, sex, or previous condition of the patient) it is very difficult to judge of the good or bad effects of any new form of treatment. The mortality in hospitals varies from 7 to 12 per cent., or in certain hospitals or in some epidemics is even higher. Probably the modification of the disease in different individuals and in different epidemics, as well as the varying mortality, is dependent upon differences in the virus at different times and in different places, and also upon differences of susceptibility in different individuals, varying grades of intensity of the infection, as well as upon other factors of which we are still in ignorance.

Death is due to the effects of the toxemia upon the nervous system and heart, or to two accidents associated with the lesions of the intestine—namely, intestinal hemorrhage or intestinal perforation—or, lastly, directly to one of the complications which occur so frequently in this disease.

The treatment, therefore, must be directed toward neutralizing the effects of the toxemia, to preventing or overcoming the evil results of the two accidents mentioned above, and to preventing complications or relieving the symptoms associated with them.

PROPHYLAXIS

In order that the spread of the disease may be prevented it is first necessary to know the mode of distribution of typhoid fever. I have already stated that apparently infection occurs only through the gastro-intestinal tract. The bacteria, so far as known, leave patients sick with the disease only in the excretions—urine, feces, and sputum. How long the bacilli can live outside the body depends largely on surrounding conditions. This point has given rise to an endless amount of discussion, but it may be stated that typhoid bacilli do not thrive outside the human body. Under the very best conditions they may live for months, but under ordinary circumstances, in competition with the other organisms in the stools, or the ordinary saprophytes with which the excretions become infected soon after leaving the body, exposed to the changes of temperature of the outside world, to the effects of sunlight, etc., typhoid bacilli die within a few days or a few weeks after leaving the body. In flowing water the latest experiments seem to show that under ordinary circumstances the bacteria live only eight to ten days, while in sewage-polluted water they live scarcely half that time. Whether the bacilli can multiply in water is uncertain; certainly they do not ordinarily do so. The exact degree of longevity is unimportant. The important point as regards prophylaxis is that the typhoid bacillus does not thrive outside the body.

As might be expected, the typhoid bacillus is taken into the body in food or drink, which is exposed to contamination by urine or feces,

or gains access through soiled objects placed in the mouth, such as dishes, spoons, or the fingers. The chief articles of diet likely to be contaminated are water, milk, uncooked vegetables, oysters, and shellfish. Probably also an important way in which persons may take typhoid bacilli into the mouth, as shown by Dönitz, in Berlin, is by bathing in contaminated river water. In such cases, especially in younger persons, the water is not infrequently taken into the mouth and may be swallowed.

To guard against infection from typhoid bacilli several procedures are open:

(1) Precautions may be taken to prevent the access of infected substances into the mouth.

(2) By preventing the infectious material being distributed from patients it is theoretically possible to stamp out and prevent typhoid fever in a given district.

(3) By artificial immunization it is possible to prevent the infection of persons exposed to the contagion.

General Prophylaxis.—The problems connected with the first method belong rather to the subject of public hygiene. This is especially true as regards water and milk, which undoubtedly are the most likely articles of consumption to be contaminated, and from which a very large number of the cases of typhoid fever take their source.

The physician having the welfare of the community at heart is often called upon to give advice in regard to the measures to be carried out to avoid infection from these sources. From the hygienic standpoint, especially as regards typhoid fever, a pure water supply, inaccessible to contamination, is one of the most valuable and important possessions of any community. It is unnecessary to refer to the great epidemics which have been traced directly to infected water, or to the diminution in the prevalence of typhoid fever which has followed directly upon the remedying of this evil. The proof that the water is so frequently the source of infection in epidemics rests not so much upon the demonstration of the bacilli in such water, for this is usually attended with the greatest difficulty, but is based on epidemiologic grounds. These in many epidemics have been more than sufficient, and to-day no one can doubt the rôle which water plays in the occurrence of typhoid fever. With improvement in the water supply alone, typhoid fever has been almost stamped out in many communities.

As regards individual prophylaxis, whenever, during epidemics or at any time, there is any suspicion of contamination of the water supply, all water should be boiled. No other method is so satisfactory. Filtering the water through porcelain may be efficacious, but there is danger connected with it, since following the cleaning of the filter, which must be done frequently, the water may be used too soon, and before the filter has been thoroughly cleaned, and instead of avoiding infection, there may be a concentration of the bacilli in the water, and so the danger may be increased.

It should be kept in mind that it has been experimentally demon-

strated that the bacilli may live a long time in ice. Under ordinary circumstances, however, it is probable, as Sedgwick and Wilson have shown, that typhoid bacilli in ice usually die within a short time, and the rôle which ice plays in the spread of the disease is not an important one. The danger of contamination from the hands of those handling the ice is probably a more real one, and it is therefore advised that ice be not added directly to the drinking water, but that the cooling be done by placing ice about the vessel containing the water.

In this country, where milk is so frequently taken uncooked, this article of food is undoubtedly responsible for many cases. It is hardly advisable, however, to insist that all milk should be boiled, but during epidemics this should be done. Attention should be drawn to the possibility of infection from milk products, as butter, buttermilk, cheese, etc. While cases have been traced directly to infected butter, it is not likely that this plays an important rôle in the spread of the disease. The danger of paratyphoid infection from the use of milk, and also from the use of uncooked meat, is probably much greater than that of typhoid infection. Kurth, Neufeld, and others have suggested the possibility of paratyphoid infections being transmitted directly from animals in this way. Fischer has reported an epidemic of 80 cases in which the original source of infection seemed to be contaminated meat. There is a very close relationship between paratyphoid infections and the cases of so-called meat poisoning, one group of the latter being caused by a bacillus, Gärtner's bacillus, very closely related to the paratyphoid or paracolon bacilli; in fact, in some of the epidemics of meat poisoning[1] the isolated organisms could not be differentiated from paracolon bacilli. The fact that these organisms have been found in the flesh, milk, etc., of infected animals renders the problem of prophylaxis somewhat more complicated than in ordinary typhoid infection. The paratyphoid bacilli, too, seem to be more resistant to external influences than do typhoid bacilli. It seems, therefore, that for the prevention of paratyphoid infections the regulations for public prophylaxis will have to be more rigid than in the case of typhoid infections, and that more attention will have to be paid to the possibility of infection from animal products.

Certain epidemics have been traced to oysters and shell-fish grown in polluted water. One only has to recall the mode of feeding of the oyster, and the large amount of water that passes through its gills, to realize the great danger of its being contaminated if the water in which it lives should be infected. Unfortunately, at present it seems to be impossible in this country to control the location of oyster beds or to prevent the contamination of the water in which they are grown. Certainly the practice of fattening oysters in the brackish or fresh water of creeks or bays, where the opportunity for sewage pollution is largely increased, is to be condemned. While Chantemesse and others have shown that oysters growing in deep salt water may contain typhoid bacilli, the chances for infection when grown here are not so great.

[1] Fischer, Festschrift zum sechzigsten Geburtstage von Robert Koch, Jena, 1903, 271.

Health officers and others caring for the public hygiene should see that vegetables eaten uncooked are not grown on ground over which there is any probability of human excreta being distributed, either as fertilizer or accidentally.

Special Prophylaxis.—It is mainly, however, with the second method of prophylaxis, as before indicated, that the physician is directly interested. By a proper understanding of the principles involved, and the exercise of all his influence in carrying out the proper measures, the physician can undoubtedly do much to lessen the occurrence of typhoid fever in the community.

There are two modes of typhoid distribution, epidemic and endemic. Either with or without a preceding endemic occurrence of typhoid fever in the district an explosive epidemic of fever may occur. Such epidemics practically always arise from the contamination of some largely consumed article of diet, such as water or milk, and the regulations to be carried out must necessarily largely rest with the boards of health and public hygienists. Prolonging such epidemics, however, even after the original source of infection has been removed, there practically always occurs a series of cases for which some other source of infection must be assumed. Also the sporadic cases and the endemic cases cannot usually be traced to any such general source of infection. It is especially the prevention of the sporadic cases and the prevention of the endemic occurrence of typhoid fever that the physician must attempt. While the endemic and sporadic cases do not make so much impression on the public mind, they nevertheless make up the great majority of the cases occurring in this country, and in themselves make the occurrence of epidemics possible.

It is due largely to the work of Prof. Koch in Germany, and to the experience in the Spanish-American War, as pointed out by the Commission[1] appointed to investigate this matter, that the true mode of infection in the great majority of cases has been made clear. The sporadic and endemic cases, and also probably many of the epidemic cases, are now known to arise by direct or contact infection. This not only means infection through direct personal contact with patients, but also infection through some intermediary agent, so long as this agent acts on single persons and does not cause wide distribution of the disease. In all cases the infection occurs by transference of the bacilli from the excretions, but while in some instances they may have been carried into the water supply or milk supply of a city or town and so give rise to a widespread epidemic, in other instances the bedding may be soiled, and the nurse or housemaid may contaminate her hands with the organisms, and, disregarding proper precautions, may transfer these to her food, or to that of some member of the family, and so infection may occur. In many similar ways readily understood the bacilli may be carried quite directly from the patient to others. Where flies have access to excreta from typhoid fever patients they may play a marked rôle in spreading the disease. The Commission appointed to investigate

[1] Reed, Vaughn, and Shakespeare.

typhoid fever during the Spanish-American War considered that flies were the most active agents in distributing the infection. Alice Hamilton, in Chicago, was able to cultivate typhoid bacilli from flies caught in the neighborhood of typhoid fever patients. Such flies could undoubtedly contaminate food or articles of diet with which they might come in contact.

Our chief aim in prophylaxis, therefore, should be to prevent the distribution of bacilli by destroying them in the excreta as soon as possible after they leave the patient. In this way we not only can prevent contact and direct infection, but by lessening the total number of cases in the community, and so preventing the chance of the infectious agent entering general sources of food and water supply, we may aid in preventing epidemics. The greatest difficulty is in the early recognition of mild cases. These mild cases are especially likely to occur in young children. Correct diagnosis, therefore, becomes an important part in the prophylaxis of the disease. This is greatly facilitated by our present bacteriologic methods, and when possible these should always be employed. But for prophylactic measures to be inaugurated it is not necessary to wait for exact, positive diagnoses, but these measures should be put into execution in all cases where there is a suspicion that typhoid fever exists.

It has seemed that by strict enforcement of these procedures, typhoid fever might be stamped out of any given district or locality, and theoretically, finally be made to disappear completely. A great source of difficulty, however, in the practical working out of this theory, even in Germany, where the most strict isolation can be carried out, has been found to be the occurrence of "chronic typhoid bacillus carriers." It has been found that persons who have previously had typhoid fever, or even those who have been in intimate contact with typhoid fever patients, but who themselves have had no symptoms of the disease, may have typhoid bacilli in their stools or urine, and may continue to excrete them for months and years without any harm to themselves, but constituting a source of danger to all those about them.

Cases of chronic cystitis with persistence of the typhoid bacilli in the urine have for a long time been described. Young reported one case in which the bacilli were present in the urine for at least seven years. Neufeld showed that occasionally typhoid bacilli might be present in the stools and urine very late in convalescence. This led Prof. Frosch to suspect that these cases might be responsible for the occurrence of so-called "typhoid houses" and "typhoid localities," in which, year after year, cases of typhoid fever occur, often, however, the cases being separated by considerable periods of time. In support of this view he drew attention to the observation of von Drigalski, who demonstrated the presence of typhoid bacilli in the stools of a man four months after complete recovery, and also of Dönitz, who reported finding typhoid bacilli in the urine of a woman who had had typhoid fever nine months before.

Lentz[1] made a special study of this question, and showed that

[1] Klin. Jahrbuch, 1905, xiv, 475.

about 4 per cent. of the cases under observation at the bacteriologic station at Idar should be classed as "chronic carriers"—that is, they excreted typhoid bacilli later than ten weeks (an arbitrary standard) after the onset of the disease. In certain of these cases the typhoid attack occurred several years before. In at least two cases typhoid bacilli were found in the stools of persons who had never had typhoid fever, but who, however, had lived in close proximity to persons with this disease. Conradi also, as well as others, has demonstrated the presence of typhoid bacilli in the stools of doctors and nurses caring for typhoid fever patients. This discovery is of very great importance as regards prophylaxis in this disease and affects the hope of entirely stamping it out.

So far the treatment of these chronic carriers with the attempt to prevent further excretion of the bacilli has been without permanent result. Urotropin and also mercurial inunctions, which have been tried in a number of cases, have only given temporary results. Vaccines have been tried, but so far without effect. The treatment of these carriers has become a question for the public hygienists to deal with. On discovering such an individual it is the duty of the physician to report it to the public health authorities. It is the duty of the physician to lend his influence in causing such an individual to disinfect his excreta and not allow them to be deposited where they may be a source of danger to others, to disinfect his hands after each visit to the closet, and to observe precautions in regard to his linen. If the person's occupation is one that would render him especially liable to infect others—milkman, cook, etc.—he should be urged and assisted to change his occupation. This entire problem is at present an extremely difficult one for the health authorities to deal with. It is better for us as physicians, however, that in our dealing with the sick we do not lay too much stress on these chronic carriers, or on the frequency and importance of delayed diagnosis, or otherwise we may be too much impressed by the danger from these sources and so become hopeless, and neglect our immediate duties in the matter.

We must remember that every case of typhoid fever in a community is an added danger. Where no precautions by isolation are taken, the chance of any one contracting the disease is directly proportional to the number of cases existing in the neighborhood. By preventing one of these cases from becoming a source of danger to others we are doing our share toward stamping out the disease. An interesting graphic chart in the report of the secretary of the State Board of Health of Michigan for the year ending June 30, 1901, shows the effect of isolation and disinfection, even where it was impossible to carry these measures out completely. Where isolation and disinfection were neglected there occurred on an average 6.72 cases in each outbreak, with an average mortality of 1 per cent. Where isolation and disinfection were observed there averaged only 2.22 cases in each outbreak, with an average mortality of 0.39 per cent. That where all cases are quickly recognized, and by proper methods are prevented from being a source of danger to others,

the infection in a community may be completely overcome, is amply shown by the results which have been obtained in Germany under the leadership of Prof. Koch. In 1902, with the aid of a corps of assistants, a laboratory was fitted up in Trier, in a locality where typhoid fever had obtained a firm hold. By bacteriologic methods of diagnosis seventy-two persons were shown to be suffering from typhoid infection. As soon as the nature of a case was established, isolation and vigorous disinfection were practised. The result was that within three months no more typhoid bacilli were discoverable, the patients were cured, no fresh cases arose, and, so far as that group of villages was concerned, typhoid fever was exterminated. Since, in other groups of villages situated under strictly comparable conditions, but where these methods of dealing with the disease were not practised, typhoid fever continued to be prevalent, it may reasonably be inferred that the disappearance at Trier was not spontaneous, but due to the methods of identification and disinfection which were used.[1] Since that time the method has been extended in Germany, a number of bacteriologic stations have been established to facilitate the early recognition of the cases, and the most brilliant results have been obtained. Obviously this complete method can be much more satisfactorily carried out in rural districts, where the population is sparse, than in cities. In Germany, where public measures may be much more under the direct control of the Government, the problem is somewhat simplified. In America such extensive public facilities for early recognition of the cases cannot be hoped for at present. It, therefore, at present devolves upon physicians to endeavor, so far as lies within their power, to carry out the prophylactic measures.

Procedures to be Carried Out.[2]—Briefly stated, these consist simply in disinfection of the urine, stools, and sputum of patients having typhoid fever as soon as these excretions leave the patient, and in the sterilization of all objects which may accidentally be contaminated by them.

Disinfection of the Urine.—Every specimen of urine should be regarded as a pure culture of typhoid bacilli. Typhoid bacilli occur in the urine in about one-third of the cases, sometimes in enormous numbers, so that on holding a test-tube filled with urine up to the light a shimmer is seen, due entirely to the bacilli, exactly as is seen in pure bouillon cultures. One should not wait for bacteriologic demonstration of the presence of typhoid bacilli, however, before instituting disinfection procedures. The bacilli may be absent one day and present in considerable numbers the next. Therefore, strict precautions should be taken in every case. The greatest care should be exercised in preventing the scattering of drops of urine over the patient, bedding, or floor, or over the hands of the attendants. In the laboratory examination of urine from typhoid fever patients the same care should be exercised as in the examination of the pure cultures of bacteria. The question as to the best solution to use for disinfecting the urine

[1] Brit. Med. Jour., 1903, i, 503.

[2] The details are taken from The Prevention of Typhoid Fever, Rufus I. Cole, Jour. Am. Med. Assoc., 1904, xlii, 1399.

has been carefully studied by Gwyn.[1] He found that for disinfection of the urine within one-half to one hour a volume of urine would require:

$\frac{3}{10}$ to $\frac{4}{10}$ its volume of 1 to 20 carbolic acid solution.
$\frac{1}{10}$ of its volume, 1 to 1000 mercuric bichlorid solution.
$\frac{1}{10}$ of its volume, 10 per cent. formalin solution.
$\frac{1}{10}$ of its volume, liquid chlorids.

For disinfection within one to two hours a volume of urine would require an equal volume, to one-half its volume, of milk of lime solution. A volume of urine may be disinfected within five to fifteen minutes by one-fortieth its volume of chlorinated lime solution.

As to the relative value of these disinfectants, he concludes:

"Milk of lime hardly deserves the name of disinfectant. Carbolic acid is of use in large amounts and in strong solutions if a speedy result is wished. Formalin is hardly serviceable on account of its cost, but is nevertheless an efficient disinfectant. Bichlorid of mercury, chlorinated lime, and liquid chlorids are of real value, are rapid in their action, and are efficient in comparatively dilute solutions."

Since, however, chlorinated lime when exposed to the air rapidly loses its strength, it is probably neither the safest nor the best disinfectant for general use. Although strong solutions of carbolic acid are required, they are efficient, not expensive, and except for their poisonous properties very suitable for this purpose. The solutions of bichlorid of mercury are also good. In making the bichlorid of mercury solution it is well to add sodium chlorid in the proportion of 0.5 to 1000 parts.

The best plan is to have a covered jar containing 1.5 liters of 1:20 carbolic acid solution, or 200 cc. of 1:1000 bichlorid of mercury solution, preferably the latter. It is very convenient to use small bichlorid tablets of known strength: the number to be used can be readily calculated. Into the jar containing these tablets, or the solution, the urine can be poured from the urinal as soon as it is voided. The jar should be emptied every day, but not sooner than one to two hours after the last urine has been added. The amounts of disinfecting fluid mentioned above are sufficient to sterilize 3 liters of urine. If more is being voided the amount of disinfecting solution should be correspondingly increased. A second jar, large enough to contain the urinal, should also be filled with the disinfecting solution, and in this the urinal should be allowed to remain constantly, except when required for the patient's use.

A very important question is the length of time necessary to continue the sterilization of the urine during and following convalescence. In most cases the bacilli disappear from the urine during the first or second week of convalescence, but, as we have stated, they may persist much longer, even for months, or in rare cases for years. These cases, however, are frequently associated with symptoms of inflammation of the urinary tract, and are so discovered, when extraordinary measures should be used to prevent the condition from continuing. So long as the symptoms are present sterilization of the urine

[1] Johns Hopkins Hospital Reports, vol. viii.

should be persisted in. In hospitals, or wherever bacteriologic methods are available, no patients should be discharged until cultures from the urine show typhoid bacilli to be absent. In Germany, where rigid measures are carried out, cultures must be negative on three occasions at intervals of ten days before the patients are discharged. Whenever such procedures are not available the patient should be urged to continue the sterilization of his urine into the third week of convalescence. Practically it will hardly be possible to have this done longer.

By a number of writers the administration of urotropin as a prophylactic measure has been urged. The evidence now is pretty conclusive that urotropin does not kill the bacteria which have gained entrance to the urinary tract, but only inhibits their growth. Therefore, according to Fuchs,[1] although when bacilluria is already present urotropin apparently causes disappearance of the bacilli from the urine, they may reappear as soon as the urotropin is discontinued. On the other hand, if the urotropin is begun as early as possible in the course of the disease it may prevent the occurrence of a bacilluria. The dose should be 2 gm. (30 gr.) daily, best given as 10 gr. three times a day. However, several cases of hematuria following the administration of urotropin have been reported, in one case after giving the above dose for seven days. I know of no case, however, in which there has been any permanent damage to the kidneys.

Under no circumstances does the administration of urotropin permit the disinfection of the urine to be neglected. Such disinfection should be prolonged as far into convalescence as possible. When possible the urine should be shown to be free of bacilli before the patient is discharged. If urotropin is administered as a routine measure it should be begun early and continued throughout the course of the disease. As the giving of drugs in this disease should be avoided as far as possible, however, I do not think it advisable to administer urotropin to every case. If typhoid bacilli are found to be present in the urine, urotropin should be commenced at once and continued into convalescence.

Disinfection of the Stools.—The determination of the best method to be employed for this purpose is much more difficult than in the case of the urine, since frequently the bacteria are imbedded in a hard firm mass of feces, which renders difficult the action of the disinfecting solution. The solutions most generally employed for this purpose are chlorid of lime, carbolic acid, and milk of lime. Bichlorid of mercury is not a suitable medium. Good chlorid of lime is very suitable, but, unfortunately, it sometimes happens that the commercial product is not good. One cannot afford to take any risks in disinfection of the stools.

Both milk of lime and carbolic acid have been found to be efficient in case certain precautions are observed. The objection to the use of milk of lime is that too often it is not prepared in the right way. Air-slaked lime is worthless. To be of use the lime should have been freshly burnt and should be mixed with water in the proportion of 100 parts of lime to 60 of water. The lime should be allowed to soak up the water

[1] Deutsch. Arch. f. klin. Med., 1903, lxxvi, 24.

slowly. The dry hydrate which results may be kept for some time, but when exposed to the air quickly takes up CO_2 and becomes worthless. To prepare the milk of lime, one mixes 1 part by weight of the fresh dry hydrate, prepared as advised above, with 8 parts by weight of water. This mixture should be prepared fresh daily.

In using the milk of lime to disinfect feces it is necessary that they should be thoroughly stirred together, and if there are hard fecal masses the fluid should be allowed to act for a long time, even an entire day. As in the case of the urine, it is well to have a jar to hold the feces for the entire day. The milk of lime should be poured over the feces in the bedpan and the mixture thrown into the jar, and covered by an excess of the milk of lime, and all thoroughly stirred together with a stick or rod kept for the purpose. The bedpan should be kept filled with milk of lime when it is not in use.

Considerable attention has been given to the details of the disinfection of the stools and urine, because it is believed that at present, even where attempts are being made to carry out disinfection, absolutely no results are being obtained. One might as well make no attempt to disinfect the stools as simply to pour over them, as is often done, a little milk of lime which has been prepared for weeks, and during this time has stood exposed to the air.

On account of the care necessary in preparing and keeping the milk of lime solution, disinfection with carbolic acid is in general to be advised. It is not an ideal disinfectant on account of its poisonous properties, but at present it is the best available. It is cheap and quite efficient when used in strong solutions. I should advise thoroughly mixing the stool with at least twice its volume of 1:20 carbolic acid solution, and allowing it to stand for several hours at least. Another satisfactory disinfectant for the stools is liquor cresolis compositus of the pharmacopeia. The stools should be mixed with an equal quantity of a 5 per cent. solution and allowed to stand at least one hour. In Germany liquor creosoti saponatus of the German Pharmacopeia is used for both the urine and feces.

The ideal method for sterilization of the feces is by heat, and this method has been employed to some extent by the English army in South Africa. The stools were boiled in large cauldrons, with a small amount of carbolic acid added, which entirely destroyed the odor. By this method the feces were rendered harmless almost instantly. The method is described by Major Cummings.[1] Such a method as this should be employed in fever hospitals and military camps, or wherever large numbers of typhoid fever patients are collected. The method, however, could hardly be employed in private houses. For use in hospitals a very satisfactory sterilizing hopper has been devised by Washbourn, and is in use in the Massachusetts General Hospital. This consists of a closed copper hopper into which live steam may be admitted. The stool is placed in the hopper, the steam turned on, and the stool is thus thoroughly disinfected; then, by opening a gate valve,

[1] Brit. Med. Jour., 1901, i, 954; Ibid., 1902, ii, 1368.

the stool is washed into the sewer. Somewhat similar hoppers are now being built by several hospital supply houses, and they should be installed wherever numbers of patients with typhoid fever are being treated.

After a stool the patient's buttocks should be cleansed with a 1:1000 solution of bichlorid of mercury. The patient should be urged to carry out the disinfection of the stools during the entire convalescence. If bacteriologic methods are available, the stool as well as the urine should be shown to be free from typhoid bacilli before the patient is discharged. In Germany the same rule holds with regard to the feces as to the urine.

Disinfection of the Bath Water.—Undoubtedly the general employment of hydrotherapy in treating typhoid fever has added another important channel by which typhoid bacilli are disseminated, and yet very little attention has been directed to this danger. The patients occasionally void urine in the bath, and there is always the danger of small fecal particles being washed from the anus into the bath water. This contaminated water is usually thrown into the common sewer. Where portable bath-tubs are used the water is not infrequently splashed over the floors. E. Babucke[1] has sought experimentally to find the best method for the disinfection of the bath water. He found chlorid of lime the best substance to use, and found that even where the water contains coarse fecal matter, 250 gm. (½ pound) of chlorid of lime will render the ordinary bath of 200 liters sterile in one-half hour. As previously stated, the quality of chlorid of lime is, unfortunately, somewhat uncertain. However, at present there seems to be no satisfactory substitute for this purpose. Since the disinfecting properties of chlorid of lime depend upon the active chlorin it contains, and as this is rapidly lost on exposure to the air, it is of importance that the powder should be purchased in small tightly closed packages; the cans with sliding tops are not sufficiently tight. When a can is once opened its contents should be used quickly, better within one to two days. If this substance is purchased in such tight, ½-pound packages, thus containing enough for only two to four baths, it will be found a very suitable and effective medium. Fortunately the tubs are not injured by it.

Other Procedures in Disinfection.—If there be any expectoration, the sputum should receive the same care as in tuberculosis. It is best to collect it in small cloths, which may be burned.

All the linen leaving the patient's bed or person should be soaked for two hours in a 1:20 carbolic acid solution or in a 2 per cent. solution of liquor cresolis compositus, and then sent to the laundry, where the articles should be boiled. All dishes should be boiled before leaving the patient's room.

The nurse should wear a rubber apron while giving tubs or working over a typhoid fever patient, and this should be washed frequently with a carbolic acid or bichlorid of mercury solution. The nurse should wear rubber gloves when giving tubs, or else soak her hands thoroughly in 1:1000 bichlorid solution after she has finished.

[1] Centralbl. f. Bakteriol., 1900, xxvii, 800.

It is impossible here to deal with all the possible modes of spreading the infection. Keeping in mind that everything leaving the patient should be sterilized, whenever there is a chance of its having been contaminated by the discharges, the physician, assisted by a nurse of ordinary intelligence, even by a member of the family, can carry out very satisfactory prophylactic measures.

Isolation of the Patient.—The question as to the necessity for the isolation of typhoid fever patients is a difficult one. To prevent direct infection of the other members of the family, a moderate degree of isolation should be carried out, though this need not be absolute, as is necessary in the exanthemas. The windows should have fly-screens in summer. After recovery the room should be disinfected. There can be no doubt as to the advantage, not only to the patient, but to the public at large, of the treatment of typhoid fever patients in hospitals. This is especially true where the patient's circumstances will not permit satisfactory prophylaxis to be carried out at home. Here the physician, assisted by the local health boards, must carry out the proper measures as well as possible.

An important question is as to the necessity for the isolation of typhoid fever patients in special wards in general hospitals. At present this is not commonly done in America. It is more frequently done in Germany, yet so eminent an authority as Professor Curschmann thinks that it is unnecessary in carefully conducted hospitals. Every one, however, who has had experience in general hospitals knows that cases of hospital infection are not uncommon. Many such cases are reported in the literature, yet, for obvious reasons, very few statistics in regard to this point are available. When, however, in a hospital with as good sanitary arrangements as the Johns Hopkins Hospital possesses, and in which all possible precautions are taken to prevent the infection spreading from patient to patient, 1.81 per cent. of all the cases of typhoid fever have been of hospital origin, the advisability of isolation of typhoid fever patients is certainly worth considering. The danger to the nurses and doctors would also be much less, as having exclusive care of typhoid fever patients, the personal disinfection and prophylactic measures could be carried out by them much more effectively.

If autopsies are performed, great care should be taken to prevent the distribution of the infectious material.

Vaccination.—In 1895 Pfeiffer and Kolle[1] described in the serum of typhoid fever convalescents, and of goats which had been inoculated with Bacillus typhosus, specific bactericidal substances. Pfeiffer had already shown the presence of specific substances in the blood, following infection with cholera, and Haffkine had devised a method for the production of immunity to cholera by the injection of killed and attenuated cultures of the cholera vibrio. In an article on the coagulability of the blood, Wright[2] mentions the inoculation of two men with dead typhoid bacilli. No attempt was made, however, to demonstrate the development of any

[1] Ztschr. f. Hyg. u. Infectionskh., 1895, xxi, 203.
[2] Lancet, Sept. 19, 1896.

reaction of immunity, and the experiments were made parallel to the anticholera inoculations simply to show the effect of calcium chlorid on the local disturbances caused by such inoculation.

Pfeiffer and Kolle,[1] however, published the results of experimental investigations concerning the protective inoculation of man against typhoid fever. They showed that the subcutaneous inoculation of dead typhoid bacilli ($\frac{1}{10}$ agar culture heated to 56° C.) was followed by constitutional symptoms lasting about a day, and after six days changes occurred in the blood of the patients, which imparted to it a bactericidal power (when tested by the Pfeiffer method) at least equal to that of the blood of convalescents from the disease. They expressed the hope that typhoid immunity depended on these changes in the blood, and suggested the use which might be made of this method of vaccination, especially in armies. Very little immediate application of the procedure was made in Germany, but in England Wright continued its study, and under his direction it has been extensively employed, especially among the Indian troops and among the soldiers in the South-African War.[2]

The following technic was employed by Wright: The bacilli are cultivated in sterile broth, twenty-four-hour cultures being employed. A strain of the typhoid bacillus is used, which yields within a twenty-four-hour limit of growth, under favorable circumstances, cultivations containing from 1000 to 2000 or more millions of bacilli in the cubic centimeter. The bacteria are killed by heating to 60° C. Formerly the dosage was determined by estimation of the toxicity for guinea-pigs. At present at the first inoculation a quantity of vaccine containing 750 to 1000 millions of typhoid bacilli is employed, and for the second inoculation a quantity of vaccine containing 1500 to 2000 millions of the same bacilli. The number of bacteria is estimated by a special method devised by Wright. Under strict antiseptic precautions the injection is made into the subcutaneous tissue over the back of the shoulder or the flank. Usually within two to three hours after the injection there occurs an erythema and some serous exudation at the site of the inoculation and along the lymphatics leading from it. Wright advised the use of calcium chlorid to prevent this serous exudation, and for the pain, which may be quite severe, he advises the application of warm stupes and of the following ointment:

℞ Acidi carbolici ..... gr. xx;
Fluidextracti ergotæ ..... ℥iss;
Zinci oxidi ..... ℥j;
Lanolin ..... ℥j.—M.

Besides the local symptoms there are more or less constitutional symptoms, coming on within two to three hours. These may be very severe, chill, high fever, etc., coming on as quickly as a quarter of an hour after the inoculation, but, with the small doses given above, the con-

[1] Deutsch. med. Wochnschr., 1896, xxii, 735, Nov. 12, 1896.

[2] A resumé of all Wright's work is given in "A Short Treatise on Antityphoid Inoculation," Westminster, Archibald Constable & Co., Ltd., 1904.

stitutional symptoms usually are limited to some headache and to two or three hours of real malaise. The following day the temperature is normal, and, except for slight pain at the seat of inoculation, the subject feels well. Wright advises that the patient partake of some nourishment immediately before or immediately after the inoculation. Instead of one severe inoculation, it is probably better to give two successive inoculations. Following the Ehrlich system of nomenclature, according to which the products of immunity are spoken of as antitropic substances, Wright has demonstrated the appearance in the blood of persons, after inoculation with the typhoid vaccine, of agglutinating antitropins, bactericidal or bacteriolytic antitropins, antitoxic antitropins, and opsonic antitropins. The occurrence of the first two immune bodies, however, has been best shown and studied, and upon this, aside from epidemiologic evidence, the chief claim as to the value of the method is based. It has been shown that immediately following the injection there is a diminution of the immune substances in the blood, the so-called negative phase, this being followed by a marked increase in these substances, a positive phase.

Bassenge and Rimpau[1] have endeavored to show that smaller doses of the vaccine cause fewer local and constitutional symptoms, and, at the same time, that the immunity induced is well marked. They gave successive injections of $\frac{1}{30}$, $\frac{1}{15}$, and $\frac{1}{5}$ oese of killed typhoid bacilli, with ten- to twelve-day intervening periods between injections. As their method of standardization differs entirely from that of Wright, it is very difficult to compare results. These writers used the method on very few cases, but they made careful studies of the bactericidal substances produced in the blood according to Pfeiffer's method, and showed that with these small doses the degree of immunity obtained was at least equal to that occurring after recovery from the disease. Since 1905 the vaccine used in the British Army has been prepared by heating only to 53° C. It has been thought that the protection offered by this vaccine lasts much longer than with that formerly employed. Castellani[2] has advised the use of living, non-virulent cultures for vaccination. He heats the cultures for one hour to only 50° C. This method has not yet been employed to any large extent.

While in the preceding methods the bacteria are injected in an intact form, in the following methods use has been made of procedures devised to cause solution of the bacteria by means of autolysis, and the products of this solution are then injected. It was thought the vaccine prepared in this way would be more readily absorbed and, therefore, would cause less local reaction. It was thought, also, that the products thus obtained would have just as high immunizing power as the whole bodies. Strong had introduced this method for vaccination against cholera, and Shiga[3] has applied the same principle to the production of a typhoid vaccine. Shiga's vaccine is obtained by making an emulsion of bacilli in sterile salt

[1] Festschrift zum sechzigsten Geburtstage, von Robert Koch, Jena. 1903, 315.
[2] Lancet, 1909, ii, 528.
[3] Berl. klin. Wochnschr., 1904, xli, 79.

solution, killing by heating one hour at 60° C., and then allowing autolysis to go on for forty-eight hours at 37° C. The bodies of the bacteria are then removed by filtration and the clear filtrates are used for inoculation. According to the method of Wassermann the bacteria are grown twenty-four hours on agar; then an emulsion in distilled water is made. The bacteria are killed by heating for one hour at 60° C., and then allowed to undergo autolysis by leaving them for five days at 37° C. This is then filtered, and the germ-free filtrate is dried to a powder in a vacuum apparatus. To inoculate, this powder is dissolved in physiologic salt solution to which is added 0.3 per cent. of phenol.

The results obtained by inoculation must be judged not only by the appearance of immune substances in the blood of the persons inoculated, but by the susceptibility of the persons after inoculation, as shown by the incidence or morbidity of the disease among these, as compared with that among the remaining population exposed to the same conditions. Probably the latter criterion is very much the more important, since so little is definitely known regarding the nature of the immunity following typhoid fever, and since the appearance of the immune substances mentioned may be a very poor indication of real immunity. From a study of the statistics obtained by Wright from the British soldiers in India and in South Africa during the war he concluded that in every series of cases except one the incidence of typhoid fever was diminished by at least one-half in the inoculated. In certain cases there was a six to twenty-eight fold reduction. Besides the diminished incidence there occurred a striking diminution in case mortality. "In the aggregate the proportion of deaths to cases among the inoculated has been rather less than half that among the uninoculated." Of the 1758 cases occurring among the inoculated, 142 died (8 per cent.), while of the 10,980 uninoculated patients, 1800 died (16.6 per cent.).

While these figures appear definite and striking, it must be remembered that the difficulty in obtaining such statistical evidence, and the chances for error therein, especially in that obtained concerning armies during active service, is very great. On the other hand, there must have been very great haste and imperfection in the details of administration of the vaccine under the unfavorable conditions. The fact that in spite of these disadvantages such striking results were apparently obtained, as indicated above, seems to show that the method has a decided value, and that great saving of life has been accomplished. In spite of the apparently excellent results, however, an Advisory Board, appointed after the close of the South African War to investigate the question, advised against continuing the inoculation in the army. A committee appointed by the Royal College of Physicians, however, supported Wright. Since the Advisory Board persisted in its opinion, a second Board was appointed, which reversed the decision of the first, and recommended that the injections be undertaken in the army. This was done, and the results of inoculation in the British Army from 1905 up to June, 1908, has been given by Leishman.[1] Of 12,083 men, comprising sixteen regi-

[1] Jour. Royal Army Med. Corps, London, 1909, xii, 163.

mental units, 5473 were inoculated. The case incidence per 1000 among the inoculated men was only 3.8, while among the non-inoculated men the case incidence per 1000 was 28.3.

The whole question as to the value of the method, especially in relation to the German Army, was taken up under Prof. Koch's direction in the Institut für Infektionskrankheiten in Berlin.[1] The consensus of opinion was that the method was of considerable value. The various modes of applying the method were investigated by Kolle, who advised that instead of the employment of bouillon cultures, agar cultures killed by heating to 60° C. should be employed. He recommended large doses in two injections; the first should be 1 oese (2 mg.) of an agar culture, and the second, given eight or ten days later, 3 oese (6 mg.), also of an agar culture. Kolle thinks that to obtain persistent immunity it is necessary that a good general and local reaction occur. For this reason he advises against small doses. With the Neisser-Shiga method, as marked or even more marked reactions were obtained as when the whole bacilli were used, while the immunity produced was apparently not so good. The results of Bassenge and Rimpau, however, as well as certain observations of Wright, would tend to show that the degree of immunity is not necessarily proportional to either the local or general reaction.

Following the advice of a mixed civil and military Medical Board appointed to study the question, the method has been lately adopted in the U. S. Army, and is being carried out under the direction of Major F. F. Russell. At present the inoculations are not compulsory, but are given to such men as offer themselves, after the matter has been explained by a medical officer. At present the inoculations are mainly limited to members of the Hospital Corps, but arrangements are being perfected so that inoculation of the entire body of troops can be undertaken if they are exposed to special danger of contracting the disease. Sufficient time has not yet elapsed for statistics to be collected.

The fact that the results of anticholera inoculation have been so satisfactory gives rise to the hope that with greater knowledge of the principles underlying the procedure and further improvement in the technic the value of antityphoid vaccination will prove very great. The duration of the protection which vaccination affords has not yet been fully determined, though there is some evidence to indicate that it may last for at least three years.

Under what circumstances should the method be employed? The entire harmlessness of the procedure is indicated by the fact that no bad results were seen among the large number of inoculated persons in the British Army. The difficulties, where the vaccine can be prepared by a trained bacteriologist, are not very great. It seems, therefore, that much greater use should be made of the method than has already been done. In epidemics or threatened epidemics in prisons, schools, asylums, etc., the method should be employed. It is a question whether the method should not be employed on doctors, nurses, and orderlies caring

[1] Klinische Jahrbuch, 1905, xiv

for typhoid fever patients. The great frequency of typhoid fever among such persons is evident from the statistics collected by Schüder,[1] which show that of 35,647 patients in six large hospitals, 3.3 per cent. occurred among those caring for the sick. Almost the same figures occur in the Prussian Army. The cases among the sanitary employees and nurses were about 3.42 per cent. of all the typhoid fever cases, and to this must be added about 1.67 per cent. of patients among other employees attached to the hospitals. In American hospitals the percentage of cases among caretakers is not so great. In Johns Hopkins Hospital 1.81 per cent. of the cases have been of hospital origin. While in civil hospitals the method of vaccination has not yet been employed, its advantages should be carefully considered.

TREATMENT

Specific Treatment.—The discovery of a specific serum which would neutralize the poisonous effects of the typhoid bacillus has been a long sought goal. Unfortunately, the hopes which were entertained have not been realized, at least no serum has yet been prepared which is generally admitted to be of value. The problem does not seem to be a hopeless one, however, and, with further knowledge of the true nature of the disease, it is possible that the discovery of the remedy will quickly follow. Possibly some of the sera now being employed are prepared according to the right principle, but they are not of sufficient strength to be effective. When it is remembered that the diphtheria serum now being used is hundreds of times stronger than that at first obtained, we feel that the production of stronger sera along the lines already pursued may possibly solve the problem. With our increasing knowledge of the exact nature of the disease, however, it seems probable that the plan so far followed has not been exactly the correct one.

All known forms of specific, biologic treatment for infectious diseases aim at overcoming the infection, either by stimulating the body to produce in the blood substances antagonistic to the infectious agent (active immunity), or by producing passive immunity through the injection of the serum of another individual or animal in which immune substances in large amount have been produced by active immunization. The therapeutic application of active immunization is based on the hope of stimulating the body to produce antagonistic substances more rapidly than occurs under the stimulus of the natural infection. While in none of the infectious diseases except hydrophobia, in which the period of incubation is a very long one, has the therapeutic application of active immunization been successful, nevertheless, many attempts have been made and are still being made to treat typhoid fever according to this principle. The antivaccination of Wright, previously mentioned, is simply an application of this principle to prophylaxis. Before we can discuss the value of the present methods of specific therapy, however, or suggest the lines along which further work may be done, it is advisable that we first consider what is known regarding the exact way in which

[1] Ztschr. f. Hyg. u. Infectionskrankh., 1901, xxxviii, 343.

typhoid bacilli produce the symptoms and features of the disease, and how the effects of the bacilli are overcome by the natural resources of the body; in other words, the nature of typhoid immunity. While, in the final analysis, the value of any method must depend upon the clinical results obtained, whether patients are cured or not, the logical method in the attempt to discover a cure is to try, first, to discover the nature of the infection; second, to find the natural method of cure; and third, to attempt to imitate this method, to stimulate the natural forces of resistance.

From what we know of the nature of infectious diseases, it seems reasonable to believe that the effects produced by the typhoid bacillus are toxic in nature, due to poisons elaborated or set free by the bacteria. The nature of these toxins, however, is not accurately known. There are several possibilities, and there have been several views advanced as to the origin and nature of these substances. It is conceivable that the poisons may be set free by the growth of the bacteria on various kinds of media, the poisons being produced either *in vitro* or *in vivo*. This is the way in which the poison of the diphtheria bacillus is produced, and it is most fortunate so far as regards the production of antisubstances and the production of passive immunity. Second, it is possible that the poison is only produced by the interaction of typhoid bacilli and living tissues, and since the production of typhoid fever in animals has not been accomplished (or possibly only in monkeys by Grünbaum), it is possible that this interaction only occurs with the tissues of the human species. This possibility is a most unfavorable one so far as the production of passive immunity in man is concerned. A third possibility is that the toxins are only set free by the disintegration of the bacilli, that the toxins are integral parts of the bacterial cells (so-called endotoxins), and, therefore, that the bacilli cause the disease by their own death. It must be remembered, however, that it is possible that the typhoid bacilli do not act by the formation of definite chemic substances, but that they may produce their results in ways entirely unknown.

But without an exact knowledge of *how* the typhoid bacillus acts, it may be possible to determine in what manner the body resists the action of the bacilli, and in this way obtain a basis for specific treatment. The resistance of the body is possibly not only due to an action antagonistic to the poisons, to the production of antitoxins, but it may depend upon the destruction of the bacteria themselves. This is hardly conceivable if the toxins are endotoxins, as then, by the destruction of the bacteria, the amount of free toxin would be increased, and harm instead of good be done.

The ways, aside from antitoxic, so far described, by which the resistance of the body is supposed to be exercised, are as follows:

(1) By the destruction of the bacteria, by means of ferment-like substances in the blood—bactericidal or bacteriolytic substances. The presence of such substances in normal blood, and in larger amounts in immune blood after infection, has been fully demonstrated.

(2) According to the well-known view of Metchnikoff, the leukocytes

form the natural resistant forces of the body to infection. This view has been somewhat modified, and it is now believed even by Metchnikoff that substances in the serum play an accessory rôle, stimulating the leukocytes to phagocytosis (stimulins), or so affecting the bacteria that they may be taken up by the leukocytes (opsonins).

What evidence is there now as to the mode of attack of the typhoid bacillus, or as to the kind of resistance on the part of the body?

As to the production of toxins by the typhoid bacillus, it is impossible to go into all the evidence or to mention all the attempts which have been made to isolate such poisons. This isolation is manifestly of primary importance for the production of a specific serum. If this specific toxin could be obtained the problem of treatment would probably be solved by the production of an antitoxin in animals, as has been done in diphtheria.

(1) *Extracellular Toxins.*—The isolation of toxic filtrates has long been attempted, and there have been numerous successful results reported. It is true that the filtrates of typhoid cultures are frequently toxic, the toxicity depending largely upon the mode of cultivation. It has been found, however, that such toxicity is not peculiar to the filtrates of Bacillus typhosus cultures, but is found to be true of the filtrates from the cultures of most bacteria, even saprophytes. Furthermore, such toxins have not been shown to be specific; that is, antitoxins specific to them have not been produced by their injection into animals. An exception to this possibility is the toxin isolated by Chantemesse from the cultures of typhoid bacilli in a bouillon media containing splenic pulp and human defibrinated blood. This is filtered after growth for five or six days, and this filtrate has been found to be fatal for an 80-gram guinea-pig in doses of 1 cc.

(2) The occurrence of *specific toxins* in the blood or tissues of man infected with Bacillus typhosus has not been demonstrated. Lately Bail has shown that if typhoid bacilli are injected into the peritoneal cavity of a guinea-pig, the exudate arising from this irritation is endowed with certain properties. The hypothetic substances to which these properties are supposed to be due have been named by Bail aggressins. While these exudate fluids are not in themselves toxic, when injected in sufficient amount into a second guinea-pig, together with a non-fatal dose of the typhoid bacillus, such a guinea-pig dies. By the addition of such a fluid to single fatal doses of typhoid bacilli, the course of the infection, as well as the pathologic findings in guinea-pigs infected by such a mixture, is different and more severe than would be expected from the bacilli alone.

(3) The attempts to isolate an *endotoxin* have yielded somewhat more promising results. Pfeiffer and others have shown that, while the filtrate from fresh cultures of Bacillus typhosus is not toxic, if the bacteria remaining after filtration are killed and inoculated into animals, this mass of cellular material is found to have a high toxicity. If the filtrates from old cultures of typhoid bacilli, which have remained in the thermostat for weeks, are inoculated into animals, it is found that the toxicity

is very much greater than that of the filtrates of fresh cultures; still far inferior, however, to that of the filtrates from cultures of diphtheria bacilli. The probable reason for this difference in toxicity is that in the old cultures the bacilli are dead, the cell-bodies have become macerated and have given up to the fluid certain toxic constituents. These so-called endotoxins have given rise to much discussion. Are these true toxins, and if so, are they specific? Most of the experimental work has tended to show that they are not true toxins in the sense that specific antitoxins can be formed to them. The general view, at any rate, has been that they do not represent the poison to which the specific effect of the bacillus is due. Certain writers, however, as Pfeiffer and Vaughan, have held the contrary view, believing that they do represent the specific toxins of the disease. Conradi,[1] by means of autolysis, produced such a highly active toxin. The typhoid bacilli were grown on agar for eighteen hours, and then an emulsion in salt solution was made, and the latter was placed in the thermostat at 37.5° C. for twenty-four to forty-eight hours, in order that the bacteria might undergo autolysis. The filtrate was then concentrated in a vacuum apparatus to $\frac{1}{10}$ to $\frac{1}{50}$ of its volume, and it was found that 0.2 cc. of this filtrate, inoculated intraperitoneally, sufficed to kill a 300-gram guinea-pig in twenty-four hours. Macfayden isolated an endotoxin in a different way. His method was to freeze the bacilli in liquid air and grind them into an extremely fine powder by a special method. This powder was then taken up in 1:1000 solution of caustic potash, centrifugalized for two hours, and the supernatant fluid treated with chloroform vapor for one-half hour. The cell-juice so obtained was found to be very toxic, although the toxicity was very quickly lost on standing. In this way toxins were obtained so strong that 0.05 cc. sufficed to kill a goat. This toxin is extremely labile and its strength markedly diminishes on standing. With it an antitoxin has been produced (see below). It therefore seems to possess two of the most important characteristics of bacterial toxins. Besredka[2] also has reported the isolation of a soluble typhoid endotoxin. The toxin is obtained by growing the bacilli on agar for sixteen to eighteen hours; an emulsion is made of these in physiologic salt solution; this is heated to 60° C. for an hour, and then concentrated to a powder in a vacuum. The dried bacilli are thoroughly triturated in a mortar with sodium chlorid until an impalpable powder results. Distilled water is now added drop by drop. To this emulsion of the bacterial bodies in the concentrated sodium chlorid solution water is added until the concentration is that of physiologic salt solution. After shaking, the mixture is allowed to stand until the following day, when the bacteria have settled out. The mixture is then placed in the water-bath at 60° to 62° C. for two hours, and then, by leaving the tube quietly for ten to twelve hours longer, the bacteria are all deposited, and above there is a layer of opalescent fluid containing no bacteria, but having the endotoxin in solution.

[1] Deutsch. med. Wochnschr., 1903, xxix, 26.
[2] Ann. de l'Inst. Pasteur, 1906, xx, 304.

Starting with 1 gm. of dried bacilli, 0.30 gm. of sodium chlorid, and 30 cc. of water, a fluid is obtained the toxicity of which is such that 0.125 to 0.25 cc. is fatal for a guinea-pig of 250 grams; 1 cc. of such fluid inoculated intraperitoneally kills a guinea-pig in three hours. This fluid is correspondingly toxic for other small animals. The endotoxin may be heated for an hour to 100° or to 120° C., or even for a half-hour to 127° C., without destroying its toxicity. It is thus seen that in this respect this endotoxin differs from the other known bacterial toxins. However, as will be shown below, Besredka claims to have produced a specific antitoxin to this poison.

Since we have no convincing evidence of the formation of toxin by the typhoid bacillus, is it possible that there is another mode of attack, as evidenced by a resistance of the body in some manner other than antitoxic?

Is there any evidence that the resistance is bactericidal? If living or dead cultures of typhoid bacilli are injected into animals in increasing doses, these animals acquire a resistance, and can finally stand a much larger dose than is possible at first. Pfeiffer and Kolle (following Pfeiffer's well-known work with cholera vibrios—the so-called Pfeiffer phenomenon) showed that if typhoid bacilli were placed in the abdominal cavity of a guinea-pig, together with serum from an animal immunized to the action of Bacillus typhosus, the bacteria would be killed and would undergo a granular degeneration (bacteriolysis). It was found that this death and disintegration of the bacilli occurred to a less extent when immune serum and bacteria were mixed in the test-tube. If the serum were heated to 55° C., the phenomenon no longer occurred, but the serum could be re-activated by the addition of normal non-immune serum. The explanation of this phenomenon is given by the well-known theory of Ehrlich; namely, that during immunization of animals to bacteria certain specific bodies appear in the blood (amboceptors) which have the property of attaching a non-specific lytic substance (complement) to the bacteria. While the amboceptors are increased by the immunization process, this has no effect on the amount of complement in the blood. Therefore, if the complement is deficient, no number of specific amboceptors will be of value in destroying the bacteria. This explains the discrepancy between the action of immune serum in the peritoneal cavity of the guinea-pig and in the test-tube. In the latter case the complement may be deficient, while in the former it is supplied by the serum of the guinea-pig. The complement is also destroyed by heating to 55° C., and this explains the second phenomenon mentioned above.

This evidence would seem to show that the immunity in animals (in part at least) is due to the development of bactericidal substances in the blood-serum. It must be remembered, however, that infection with typhoid bacilli in animals is a very different thing from typhoid infection in man. The pathology and clinical features are entirely different, and it is probable that the nature of the immunity is not the same. Pfeiffer and Kolle showed, however, that the peculiar property of the serum de-

scribed by them was also common to the blood of patients convalescing from typhoid fever. We have not yet a clear idea as to the changes of this kind which occur in the blood of typhoid fever patients. It is manifestly evident that unless there be a sufficient amount of complement present no number of amboceptors will have any value in destroying the bacilli. There are very great discrepancies in the work so far done in regard to the bactericidal power of the blood during and following typhoid fever in man. Evans,[1] from the results of his study of the bactericidal power of the blood in 29 cases during convalescence from typhoid fever, concluded that the variation was within such very wide limits that no conclusions could be drawn. He, however, did not attempt to make quantitative estimations of the amount of complement present. With a different method Stern and Korte found that the bactericidal power of the blood was increased during and following typhoid fever, even going so far as to use this increase as a diagnostic sign of the disease. Korte and Steinberg[2] found no relation between the bactericidal power and the grade of infection—relapses occurred even in patients with high bactericidal power; Richardson[3] showed in a very few cases an apparent diminution in complement during typhoid fever; and Longcope[4] showed in 3 cases a diminution of the complement. Denison[5] has demonstrated that although, during the height of the disease, the increase of amboceptors in the patient's blood may be very great, there is a lack of available complement. It must be borne in mind, however, that the evidence is not yet conclusive that in man recovery from typhoid infection is due to the production of bactericidal substances. Possibly, further work may show this to be the case.

Role of Leukocytes in Overcoming Typhoid Infection.—As the leukocytes are diminished in typhoid fever, and as there has been no parallel determined between recovery and an increase of these cells in the circulating blood, it is not likely that a mere increase in number of leukocytes plays any rôle in recovery or immunity. On the other hand, Hektoen and others have shown that in typhoid convalescents the opsonins are greatly increased; and Klien[6] has shown that during the process of immunization of a rabbit against typhoid bacilli, opsonins are formed in a high degree. Whether these facts mean that natural or artificial immunity to typhoid fever depends, to any considerable extent, on the production of opsonins or not, is not yet definitely decided.

Methods of Cure in the Light of Above Observations.—(1) *Active Immunization.*—I have already discussed this method of producing immunity in man as a means of prophylaxis. Even after infection has occurred, and during the course of the disease, Krüger, Fränkel, Rumpf, and others have injected dead bacilli, hoping in this way that the immune substances might be stimulated to appear in greater number in the body,

[1] Jour. Path. and Bact., 1903–04, ix, 42.
[2] Deutsch. Archiv. f. klin. Med., 1905, lxxxii, 321.
[3] Jour. Med. Research, 1901, vi, 187.
[4] Jour. Hyg., 1903, iii, 28.
[5] Bull. Johns Hopkins Hosp., 1908, xix, 263.
[6] Ibid., 1907, xviii, 245.

and that the method might, therefore, be employed as a means of cure, but without, however, obtaining any favorable results. Petruschky[1] also injected dead bacilli in very small doses with what he considered favorable results. The preparation of dead bacilli treated in a special way was named by him "typhoin."

More recently, as a result of the propaganda of Wright in favor of active immunization in acute infective processes, there have appeared several reports of the treatment of typhoid fever by vaccines. Semple has treated 9 cases in this way, all with recovery. He advises using an homologous vaccine, giving 15,000,000 to 30,000,000 daily, for from four to six days in succession. Smallman[2] has treated 36 cases with 3 deaths, 8.3 per cent. mortality. He at first gave doses of 100,000,000, but later he gave larger doses and repeated them at frequent intervals. Nichols has treated 8 patients with large doses, 150,000,000 to 160,000,000, given at intervals of several days. All recovered, but Nichols could not see any special effect of the vaccine, favorable or unfavorable. Relapses were not prevented. Walters and Eaton have reported 30 cases with 2 deaths. They gave small doses, 25,000,000 to 40,000,000 bacteria. A review of these reports does not lead one to think that this method of treatment is very promising. However, it is apparent that the administration of vaccines is not harmful, and it is possible that further experience may show that this method of treatment may exert a beneficial influence, at least in certain cases. The experience so far is not sufficient for any rules to be laid down as to dosage, mode of administration, etc.

Richardson[3] has used the filtrate from bouillon cultures for injection into patients as a means of cure. Although this filtrate in itself is not toxic, the theory of the method of cure must be that of an active toxin immunization, although Richardson does not go fully into the theories or reasons why he was led to employ this method. He has treated in this way 74 cases, with a mortality of 14.8 per cent. The inoculations were not infrequently followed by chill and increased elevation of temperature. Richardson thinks that the tendency to relapse was apparently increased. The results in this series of cases certainly hardly justify further attempts being made along this line. Indeed, it is difficult to see where there is any evidence, experimental or otherwise, which would lead one to expect this method to have any value.

Vaughan[4] has elaborated an interesting theory concerning the pathogenesis of typhoid fever, and has suggested a mode of treatment based on this theory. He has found that the protein constituent of the bodies of typhoid bacilli, by extracting at 78° F. with a 2 per cent. solution of sodium hydroxid in absolute alcohol, may be split into two portions, one of which is soluble in absolute alcohol and is poisonous, and a

[1] Deutsch. med. Wochnschr., 1902, xxviii, 212.
[2] Jour. Royal Army Med. Corps, Lond., 1909, xii, 136.
[3] Jour. Med. Research, 1905, xiii, 301; Boston Med. and Surg. Jour., 1907, clvii, 449.
[4] Am. Jour. Med. Sci., 1908, cxxxvi, 330.

second portion which is insoluble in absolute alcohol and is non-poisonous. This latter portion he calls the bacterial residue, and he thinks it is to this non-poisonous residue of the bacterial body that the bacteria owe their specificity. He thinks "this is the specific part of the cell; it is the antigen or the haptophor, and in it lies the most promising hope for the specific treatment of typhoid fever." By intraperitoneal injection of this residue guinea-pigs may be immunized against the living bacillus. I cannot go here fully into the theory of Vaughan as to the nature of this immunity. However, he thinks it is due to the development in the body of the treated animal of a substance or ferment which splits up the bacterial protein so as to set free the poisonous constituent. The injection of the residue stimulates the development of this ferment. If this can be done early in the disease, before there are sufficient bacteria present to furnish a fatal amount of the poison, the animal recovers. If, on the other hand, there are sufficient bacteria present to set free a fatal dose of the poison, the administration of the residue would be harmful. Treatment with the residue might, therefore, theoretically prove a "two-edged sword." He thinks, however, that larger doses of the residue, by absorbing or combining with the specific proteolytic ferment, may retard the cleavage of the bacillus, diminish the quantity of poison set free at a given time, and save the life of the patient. M. W. Richardson[1] has treated 21 cases of typhoid fever with the residue furnished by Vaughan. From his analysis of these cases no special effect of the treatment is made evident. Two of the patients died. Among 40 cases, however, in which Richardson[2] attempted to prevent relapse by the continued inoculation of small doses of the residue at increasing intervals during convalescence, relapse occurred in only 2 cases, or 5 per cent. Among 163 cases, on the other hand, in which no such treatment was employed, relapse occurred in 35 cases, or 21.4 per cent. These results would speak for the correctness of Vaughn's theoretic conclusions above cited. Certainly, this work is justification for further investigation.

(2) *Passive Immunization.—Antitoxic Treatment.*—As previously stated, no specific soluble toxins formed by the growth of the bacteria have yet been demonstrated, if we except the observations of Chantemesse. With the toxin isolated by him he inoculated horses and obtained a serum which he has claimed has been efficacious in the treatment of typhoid fever.

Up to 1907, Chantemesse and his colleagues report having treated 1000 cases with this serum, with a mortality rate of 4.3 per cent. At the same time there were treated in other Paris hospitals, without the use of the serum, 5621 cases, with a mortality rate of 17 per cent. Chantemesse states that of the patients given the serum before the seventh day not a single one died. Following the injection of the serum there occurs a period of reaction, lasting three to five days, the duration depending upon the severity and period of the disease; during this period an hypertrophy of the lymphoid tissues and a leukocytic increase in the

[1] Boston Med. and Surg. Jour., 1907, clvii, 449.
[2] Ibid., 1908, clviii, 127.

blood occur. Following the period of reaction occurs a period of defervescence. This may occur as a sharp crisis, as in pneumonia, but more often as a lysis. In severe cases it is sometimes necessary to give a second smaller dose, when again there occurs a short period of reaction. Chantemesse states that with the improvement the pulse becomes slower, the blood-pressure rises, the general mental condition of the patient improves, the headache disappears, and urinary secretion is stimulated. With this method of treatment convalescence is short and the complications are fewer. Among 27 fatal cases, however, there occurred 9 cases of perforation. All these occurred among the cases receiving the treatment late in the disease.

A study as to the exact nature of this serum and as to its action has been made by Balthazard.[1] He has made a very complete study of the action of the toxin on rabbits, and has shown that it has a very destructive action on the polymorphonuclear leukocytes, which almost completely disappear from the circulating blood. Following this, hyperleukocytosis occurs, which lasts several days. The spleen enlarges, due to the increase in macrophages, the function of which, he thinks, is to remove the dead and altered leukocytes from the circulating blood. He considers that the polymorphonuclear leukocytes play the main rôle in the resistance of the body to the typhoid infection. They attach the toxin to themselves, and so undergo destruction, but in this way they protect the fixed cells against the action of the toxin. If the toxin be injected directly into the brain, death occurs very quickly, and Balthazard thinks that this is because there are not sufficient leukocytes to protect the fixed cells. To meet the destruction of the leukocytes, the activity of the bone-marrow increases. He thinks the resistance in man is due to a similar cause. The antityphoid serum has an agglutinating power, but seems to have no bactericidal power *in vitro*. He thinks that it protects the animal by rendering the phagocytes less resistant to the action of the toxin, and by stimulating the leukopoietic organs. Tested experimentally, rabbits may be protected by it against four lethal doses of the toxin. When, however, it is injected at the same time as the toxin it is able to protect only against two lethal doses. When the injection follows that of the toxin, its action is variable and slight. It is thus seen that, experimentally, its antitoxic power is not very great, and its mode of action, according to Balthazard, differs materially from that of any other known antitoxic serum.

Chantemesse thinks the action of the serum is antitoxic, but only in an indirect manner, because the dose employed is so small (a fraction of 1 cc.), and, strange to say, it is advised that the more severe and prolonged the case, the smaller should be the dose. It is not probable that it owes its value to any bactericidal power it may have. Chantemesse thinks, like Balthazard, that it acts by stimulation of the leukopoietic tissues—lymphoid and myeloid tissues. The main evidence for this is the fact that, following the injection, the enlargement of the spleen becomes greater, and the blood on the day following the injection shows an increase of polymorphonuclear leukocytes, a diminution in the number of eosino-

[1] Toxine et antitoxine typhiques, Thèse, Paris, 1903.

philes, and an increase in the number of large mononuclears. Lately, Chantemesse has advanced the view that the action of the serum may be due to the stimulation of the body to an increased production of opsonins.

Studying the results of this form of treatment critically, one must be struck with the favorable mortality statistics. Yet we must not draw too wide-sweeping conclusions from these. It must be remembered that many of the patients of Chantemesse apparently were treated with the serum very early, and in this way the disease was thought to be cut very short, but everyone knows that the accurate diagnosis of typhoid fever in the early stages is attended with very great difficulty.

It is unfortunate that it has not been possible to obtain this serum for study outside of France. Even in Paris, however, the results of this mode of treatment are looked upon with considerable skepticism. Although this serum has now been employed by Chantemesse for several years, and notwithstanding the favorable reports, there still exists considerable doubt as to its efficacy, and final judgment will have to be deferred until it has received more general application and a wider study.

Serum Treatment. Passive Immunization.—As I have previously stated, no active soluble toxin has yet been isolated from the cultures of typhoid bacilli, and, therefore, it has been impossible to prepare any antitoxic serum for typhoid fever, as has been done for diphtheria and tetanus. Nevertheless, there have been a considerable number of experiments made in the treatment of typhoid fever with the serum of animals immunized by the injection of the bacteria themselves, or by injection of extracts of the bodies of the bacteria. All sorts of animals have been employed for immunization purposes—horses, rabbits, guinea-pigs, even the hog.[1] Such sera may owe any power they may have to anti-endotoxins or to bacteriolysins, opsonins, etc., which they may contain. I may say that so far none of these sera have been shown to have any considerable value in the treatment of typhoid fever. Some of them, however, have been shown to have some effect in protecting experimental animals from injections of the bacteria. Conradi and Macfayden both claim to have produced antitoxic sera by injection into animals of the toxins isolated by them. Macfayden used goats and obtained a serum of such strength that 0.02 cc. protected a rabbit against 30 lethal doses of the toxin. The serum obtained had marked agglutinating and bactericidal power, as well as being antitoxic. The results seemed promising, but, so far as I am aware, no experiments were made to test the therapeutic value of this serum in man.

Besredka[2] also attempted to produce an anti-endotoxic serum by the injection of small doses of the entire cultures of typhoid bacilli into horses. He obtained a serum that injected in doses of 0.05, 0.1, 0.2 cc. would neutralize 5, 10, and 12 minimal lethal doses of the toxic cultures, while 1 cc. of normal serum would only neutralize 2 minimal lethal doses. An experimental animal might be saved by the injection of the immune

[1] Stokes and Fulton, Jour. Am. Med. Assoc., 1905, xliv, 1504.
[2] Am. de l'Inst. Pasteur, 1906, xx, 149.

serum into the peritoneal cavity one hour after the animal was inoculated. With this serum also no extensive therapeutic experiments in man were made. Several years ago a serum of this kind prepared under the direction of Prof. Tavel of Bern was employed to some extent. It was prepared by injecting horses, first with filtered cultures, then with the dead bacilli, and finally with living bacilli. Good therapeutic results were reported by Tavel, Du Mesnil, and others, but apparently they were not favorable enough to justify its continued use.

M. W. Richardson, of Boston,[1] has also employed a serum treatment in 35 cases. He obtained this serum by injecting horses with gradually increasing doses of killed bouillon cultures of typhoid bacilli. These injections were given over a period of one to two years. In 5 cases the serum was administered subcutaneously in doses of 50 to 100 cc.; in 18 cases it was given by mouth or rectum, or both, in doses of 100 to 1000 cc. daily; in 7 cases it was given in "pill form"; and in 5 cases it was given subcutaneously, together with equal amounts of normal serum as complement. While the mortality in the series was only 5.7 per cent., Richardson does not think that the serum had any special effect.

It is thus seen that the efforts to use such sera in the treatment of typhoid fever in man have led to disappointing results. On the other hand, a number of these sera have been shown to have some protective power in animals. In most cases it has not been determined upon what this protective power depends. They usually have considerable bactericidal power when tested *in vitro* or *in vivo*, as shown by the Pfeiffer phenomenon. Such sera also usually show an increased opsonic and agglutinating power. It is possible that one reason why such sera have not proved more advantageous in treatment is that given by Wassermann; namely, that during the course of the disease there may be a deficiency of complement in the blood, and no matter how many free amboceptors are introduced, the bacteria are not killed. It was with the idea of adding to the available complement that Richardson injected normal serum in the experiments mentioned above. The results, however, as stated, were not very promising. Even though we could introduce additional complement in this way, however, the practical difficulties in the way would be considerable. The serum of another species could not be used on account of the toxic effects of the large amounts that would be required, and the danger of inoculating other infections, such as syphilis, would probably preclude the general use of human serum. In the use of bactericidal sera it must be remembered that an excess of amboceptors, instead of being of value, may prove harmful. Chantemesse, Pfeiffer, and others have described such effects in the experimental production of immunity in animals. Neisser and Wechsberg have explained this as an "ablenkung" of the complement by the excess of amboceptors. A more detailed discussion of this phenomenon cannot be entered into here.

Treatment with the Serum of Convalescents.—In addition to the use

[1] Boston Med. and Surg. Jour., 1907, clvii, 449.

of the serum of animals immunized to Bacillus typhosus or its toxins, the serum of patients convalescent from the disease has been employed, in the hope that such serum might contain the specific immune substances. Such attempts have been made by Hammerschlag[1] and others without, however, obtaining results sufficient to justify the continuation of this procedure. Theoretically, the blood of convalescents should contain the protective substances, but they may be present in very small amounts. Hammerschlag, however, transfused very large amounts of blood without result.

Treatment with the Typhoid Extract of Jez.—This method of treatment, which has received considerable application, is based on the observation of Wassermann and Takaki[2] that in animals, after a single intravenous or subcutaneous injection of typhoid bacilli, the bone-marrow, spleen, and lymph-glands contain immune substances (amboceptors) in a concentration greater than that in the blood or, at least, equal to it. They, therefore, thought that it is chiefly the cells of these organs which are endowed with receptors for the typhoid bacilli, and, therefore, that these organs are the chief seats of formation of the immune substances. (It may be mentioned, however, that Wassermann and Citron[3] later showed that this observation was influenced largely by the mode of inoculation. If, instead of making the injection subcutaneously or intravenously, it be made directly into the pleural or peritoneal cavities, the cells lining these cavities react to the infection by the production of immune bodies as actively as do the organs above mentioned.)

Based on the assumption that in infected animals the immune substances are mainly produced in the spleen, bone-marrow, lymph-glands, brain, spinal cord, and thymus, and, therefore, are present here in largest amounts, Jez made an extract of the above-mentioned organs of rabbits which had been immunized by the intraperitoneal inoculation of increasing doses of cultures of living typhoid bacilli, and killed two or three days after the last injection. Immediately after death the organs were removed and rubbed up with a mixture of salt solution, alcohol, glycerin, and a small amount of carbolic acid. This mixture was left for twenty-four hours on ice, and the filtrate from this formed the extract employed.

Jez has recorded the use of this serum in 50 cases[4] with, what he considers, very good results. He thinks it acts favorably on the pulse and temperature, prevents mental stupor and depression, and shortens the course of the disease. He does not state the mortality in these cases. The extract is given *by the mouth*, a teaspoonful every one to two hours, according to the severity of the disease, until remission occurs, then every two hours until the morning temperature is normal, after which a teaspoonful is given three times a day.

[1] Deutsch. med. Wochnschr., 1893, xix, 711.
[2] Berl. klin. Woch., 1898, xxxv, 209.
[3] Ztschr. f. Hyg. u. Infectionskrankh., 1905, i. 232.
[4] Wien. klin. Wochnschr., 1901, xiv, 84.

This extract has received considerable application, largely on account of the recommendation of Eichhorst, who tried it in 12 severe cases with apparently good effects on the course of the disease. All of the patients recovered.

A test of this extract by Markl[1] showed that it contained immune substances, but in smaller amounts than the corresponding sera. This method of treatment must be considered to be still in a very crude state and its efficiency is very doubtful. The same objections hold here as to the use of bactericidal serum, and from Markl's work it is doubtful whether serum may not just as well, or even better, be employed. The clinical reports as to the value of this extract are conflicting, and a critical study does not offer very great encouragement for the continuation of its use.

Considerable space has been given to the specific cure of the disease, not because the results obtained so far have been of much value, but because it is only by further work along this line that is seems we may hope further to reduce the mortality in typhoid fever and finally cure all cases.

General Management, Nursing, Hospital Care, etc.—With the development of the methods of hydrotherapy and the increased requirements in nursing, it has become more and more common for typhoid fever patients to be treated in hospitals. This I feel is as it should be, for, except in the case of the very well-to-do, there can be no question that the care in hospitals is better than can be obtained at home, the patient's chances for recovery are improved, and during the course of this most troublesome disease the patient is more comfortable. Regarded from the standpoint of expense, it is evident that in most cases it is essential that patients be looked after in hospitals if they are to receive the nursing and treatment which are now regarded as almost absolutely necessary. Typhoid fever patients should be carefully watched, the nursing by night should be the same as that by day, so that for the proper care two nurses at least are required. It has been said that if one had to choose whether he would have a good doctor and no nurses in typhoid fever, or good nurses and a poor doctor, it would be advisable for him to choose the latter alternative. Both doctor and nurses are important, however, for while the details of the treatment in the ordinary case must be largely in the hands of the nurses, the importance of the doctor's care in looking out for the unfavorable features and in giving treatment to guard against these, should not be underestimated.

I have already discussed the question of the necessity for isolation. This is not only of importance in prophylaxis, but I believe the patients themselves would be better off if they could be placed in wards where only typhoid fever patients are treated, rather than scattered through general wards, oftentimes in close proximity to surgical patients, where the noise, excitement, and general disturbance are sometimes considerable. The ideal method would be to have every typhoid fever patient in a separate room; with patients who can afford the additional

[1] Wien. klin. Wochnschr., 1902, xv, 65.

expense this should be insisted upon as of considerable importance. However, even in general wards, the patients are usually quieter than they would be under ordinary circumstances at home. Since the expense of separate wards for the care of typhoid fever patients exclusively has prevented their being employed to any extent in hospitals, it seems that, under ordinary conditions, typhoid fever might be treated in temporarily constructed wards, or even tent wards, since the greater number of cases occur in the late summer and early fall when the weather conditions are favorable. Such tents have been employed to a small extent on the grounds of the Boston City Hospital, especially during the years 1898 and 1899 for the care of the soldiers returning from the camps during the American-Spanish War. They have proved successful from the standpoint of the patient and of the nursing and hospital management.

It is important that the general public and also physicians should learn the importance of placing patients in hospitals early, before the disease has progressed. Patients moved during the height of the disease often do badly, and I have seen patients brought into hospitals after long railway journeys, during which they had been allowed to exert themselves, in a condition which was certainly much worse than it would have been had they remained at home, and it was doubtful whether the improved nursing and surroundings in the hospital might compensate for the harm done by the journey. This question, therefore, should be very carefully weighed when the point arises as to moving patients into hospitals during the course of the disease. Unless the conditions at home are very bad, and unless it is absolutely impossible to have the nursing moderately well carried out, it is better in such cases to leave the patients quietly at home.

The first essential in the management and nursing of typhoid fever patients is to see that they get absolute quiet and rest. A judicious letting alone is a very important part of the nurse's duty, and she must act also as a constant guardian, warding off anything which may annoy or excite the patient. If possible the patient's friends should be kept entirely out of the room or, at most, not more than one member of the patient's family should be admitted daily, and this only for a very short time. This is rendered somewhat easier by the fact that, in general, typhoid fever patients do not desire company, and much prefer to be let alone. It is hard for the public, however, to understand the importance of this regulation, but it is one of the most important points in the care of typhoid fever patients, and a physician with a stiff backbone can do a great deal toward the recovery of his patient by insisting on strict isolation, even if such efforts are usually little appreciated by the patient's friends. It is hardly necessary to say that from the time the diagnosis is made or, better, from the time the diagnosis is suspected, the patient should be kept absolutely in bed, and not allowed to sit up under any circumstances. His food should be given to him, he should not be allowed to exert himself during the bath, and men should not be shaved. We lay stress upon these details here because we feel that if these regulations were more carefully carried out during the early period of the disease fewer patients

would suffer from the nervous and mental symptoms which often are so distressing. It is hardly necessary to say that the patient should not be allowed to read; it is much better that he receive no letters, and business matters or other affairs should be arranged at the very onset, so that the patient need not have these on his mind. I know of one case, a physician, who daily dictated a letter, and following this there was each day a rise of temperature. As soon as this dictation was stopped the temperature level remained low. Even a talkative, gossiping nurse may do much to cause the temperature to be elevated, and her good efforts in other directions may be more than counterbalanced by her bad habits in this.

Arrangement of the Room.—In wards it is better that patients be not constantly surrounded by a screen, as the stimulation of curiosity as to the surrounding noises does more harm than the partial isolation does good. We have previously stated that, when possible, it is far better that patients should be treated in single rooms. The room should be as simple and plain as possible. It should contain no furniture except that absolutely required; if possible the walls should be absolutely plain, and there should be no pictures or other articles which are likely especially to attract the patient's attention during the periods of slight delirium or mental wandering during the fever. Such objects may prove the greatest source of annoyance, and I know of one physician who, many years after the attack of fever, still clearly remembers the carved lines on a fairly simple marble mantle, the mental distress and annoyance occasioned by the tracing out of these lines with his eyes, and the mental effort in attempting to conceive of them running in other patterns. More complicated ornaments and pictures may give rise to definite illusions in the minds of the fever-stricken patient.

When we remember how frequently delirium is a symptom in typhoid fever, and how often it may be acute, even violent, we can see the necessity for having the windows securely fastened or, if ventilation is to be obtained through the open windows, having them carefully barred. The windows should be well screened, both as a means of prophylaxis in keeping out flies and also of comfort to the patient in keeping from him this additional source of annoyance.

The room should not be kept constantly darkened, but very bright daylight should be kept out, unless possibly for a part of the day, when the patient's eyes may be covered. It is of great importance that the ventilation be good and that the room be kept cool. In hot weather an electric fan at the foot of the bed is grateful to the patient, does no harm, and may be of value in keeping him cool. The bed should be of the simple iron hospital variety, and should be high, at least 28 inches from the floor. This not only permits more easy examination by the physician and lightens the labor of the nurse, but very much reduces the strain on the paitient in lifting him in and out of tubs, if this form of hydrotherapy is employed. The mattress should be firm; best a hair mattress placed on woven-wire springs. The mattress should be cov-

ered first with a rubber sheet and then with a cotton sheet, which should be drawn tightly to prevent wrinkles. The pillow also should be firm, and best covered by a rubber case inside the cotton one. Attention has been drawn to these details because they are so important in the prevention of decubital ulcers, and the physician should always feel that it is as much his duty to guard against these as it is the nurse's, and in case they develop, he should always feel that he is as responsible as the nurse. With a soft bed, so that the patient sinks down and draws the skin tightly over the emaciated bones, bed-sores are almost certain to form. Even permitting crumbs or other small particles to accumulate in the bed may cause abrasion of the skin and the beginning of bed-sores. The patient should be covered with as little as possible, preferably only a sheet. The gown should be of cotton, and it is advisable to have it open in the back, so as to facilitate its removal as well as avoid inconvenience in the examination and care of the patient.

Bathing.—The patient should receive a thorough bed-bath each day with soap and water, following which the skin should be thoroughly rubbed with alcohol. Special attention should be given to any areas over which the skin appears at all tense and red. Care should be taken to clean about the genitalia. In case there is any question as to the danger of bed-sores, very frequent massage and alcohol rubbing should be employed. Some nurses use a slice of lemon to rub over such suspicious places with what are stated to be satisfactory results. Care should be given to the placing of toilet powders in all folds of the skin and where moisture has accumulated. Special attention should be given to the care of the mouth and teeth. With better nursing and improvement in methods, the dry, cracked, bleeding lips and sordes on the tongue, formerly so frequently seen, have almost entirely disappeared, so that we now feel that the occurrence of such conditions is a reflection not only on the nurse, but on the doctor as well, for it should be a part of his duty to make sure that the details of nursing are being properly carried out. The teeth should be brushed daily, using some suitable tooth paste or wash, or if the patient's condition is not such as to justify brushing, they should be carefully wiped with small pieces of gauze wrapped over the finger of the nurse, wet with a suitable mouth-wash, such as the following, which is employed in the Johns Hopkins Hospital:

℞ Liquor antiseptici ..... ℥iij;
Acidi carbolici ..... ℥iij;
Glycerini ..... ℥j;
Acidi borici ..... ℥j;
Aquæ ..... q. s. ad. ℥v.—M.

The tongue should also be carefully cleaned, and this thorough cleansing of the mouth should take place after feeding. If the lips are very dry they should be moistened with vaselin. Attention should be paid to the hair, and in women who are very ill this should be cut closely early in the disease. In the mild cases, however, this is not necessary.

Careful records of the temperature and pulse should be made every

two hours by the nurse, and these should be charted, as such charts are of great value in diagnosis early in the disease and later on are of importance as indicating the patient's condition. The temperature may be taken in the mouth, in the axilla, or in the rectum. The last mentioned is the best, but, when the rectal temperature is taken frequently, great care must be taken in inserting the thermometer so as not to cause unnecessary discomfort and not to irritate the mucous membrane, or, otherwise, the further employment of this method will be impossible. The thermometer should be carefully sterilized after each use by placing it in a carbolic acid solution.

General Management in Private Houses.—I have entered so fully into the question of nursing and management of typhoid fever patients in hospitals that little remains to be said, except that the ideal hospital conditions should be imitated as closely as possible. As soon as a diagnosis is reached, the patient should be placed in the most quiet room of the house, and this should be large, light, and airy, if such a room is available. All unnecessary furniture should be removed. If possible, the room should be in proximity to the bath-room, to facilitate obtaining water in case sponges and baths are given. Of course, how nearly the most favorable conditions may be realized will depend entirely on the size and arrangement of the rooms. Under bathing I will discuss very fully the different methods to be employed and consider their applicability in private houses. A trained nurse, wherever possible, should be employed, but if this cannot be done, one member of the family should be given charge of the details of nursing, and should be instructed as fully as possible as to the procedures to be carried out. Special directions as to the methods of prophylaxis should be given and great emphasis should be laid upon the necessity for this. The doctor should consider it a most important part of his duty to introduce measures tending to prevent the spread of the infection to other members of the family. While in many cases circumstances are such that it is absolutely beyond his power to carry out completely the measures he should like, yet in every case he should consider it a reflection upon his skill and care when other cases arise, and happy is the physician who, under such circumstances, can feel that he deserves no self-reproach. The general question of prophylaxis has been so fully discussed that further consideration here is unnecessary. I would lay special emphasis, however, on the necessity of carefully boiling all dishes coming from the sick-room before they are returned to the general kitchen. All water consumed in the house should be boiled, no matter what the supposed source of the infection, and the family should be cautioned against the eating of uncooked food during the period that the patient remains in the house. The greatest trouble will occur during convalescence; the family must be carefully instructed as to the danger of the patient spreading the infection during this period, and the rules previously mentioned should be carried out in all strictness. After convalescence the room should be thoroughly disinfected before it is again occupied.

Diet in Typhoid Fever.—Curshmann states, in his article on typhoid

fever, that "with regard to few points in connection with typhoid fever is there at the present day such satisfactory agreement as with regard to the dietetic management, of which the principles can be considered as fully established." A review of the literature on this subject, however, for the past few years shows that this opinion must be modified, for the discussion which began even before Hippocrates has not yet ended. It would appear from what is stated by Galen that the most diametrically opposite modes of practice were long ago followed by different individuals; that some starved their patients altogether for a considerable time; whereas, on the other hand, a physician by the name of Petronos allowed his patients flesh and wine.

To one who is possibly slightly prejudiced, it seems that a great deal of the discussion in regard to the diet in typhoid fever is one of much ado about nothing, and that the so-called new feeding method, which apparently on the face of it seems a very fundamental change, in practice is really only a modification of the method long in vogue, and of not much more importance than the long discussion of Hippocrates, whether ptisan (barley gruel) should or should not be given in fevers, whether it should be made thick or thin, whether it should be strained or unstrained, etc.

Since the true nature of typhoid fever, its etiology and pathology, were so little understood before the time of Louis, it seems hardly likely that the experience in practice before that time can be of much value at present. It must be remembered, however, that our present treatment must be largely empiric, and as the treatment of typhus differs in no essential from that of typhoid, and since, what too often is forgotten, our treatment is very little influenced by our knowledge of the intestinal ulceration, it may be well briefly to inquire as to the diet in continued fevers formerly employed, and to try to trace historically, if possible, the origin of our present method of dietetic management, This has been well done by Nichols,[1] from whose article many of the details in this discussion have been taken.

The whole treatment of fever up to the early part of the last century was much influenced by the inflammatory or "phlogistic theory" of fevers, and was based upon the "antiphlogistic method." Fevers were divided into phlogistic and asthenic, the former requiring vigorous depleting measures—bleeding, purging, starvation, and so on. This theory probably had much to do with the practice of low dieting in fevers, especially the exclusion of animal foods of all kinds. Stress should be laid on the fact that this restricted diet was employed long before there was any knowledge of intestinal ulceration in this disease. In the continued fevers food was almost entirely farinaceous. Sydenham gave water-gruel, barley-gruel, and the like, also a few spoonfuls of broth two or three times a day, and beer. The prohibition of animal food embraced not only meat but also eggs, broth, beef-tea, meat extracts, etc., and so deeply was the professional mind imbued with the idea of the essential harmfulness of animal food that a marked prejudice against even broths and bouillons persisted down even to a recent date. Most

[1] Med. Record, 1905, lxviii, 171.

authorities, using Hippocrates as authority, condemned milk, placing it between vegetable and animal food in its heat and excitement-producing qualities. Throughout the eighteenth century free drinking of water was encouraged, and Nichols states that there were even then some who believed in the efficacy of an aqueous diet. In the early part of the nineteenth century, under the teaching of Broussais, the antiphlogistic régime became more strict, profuse bleeding was employed, and the diet was extremely limited, being confined almost entirely to sweetened or acidulated drinks. In the early part of the century there was apparently much discussion of what was considered quite an innovation in the management of fever. Robert James Graves (1797–1853), of Dublin, rejected the phlogistic theory of fevers and advised a more liberal diet. It is he of whom is related once having said to his friend, William Stokes, "Will you, when my time comes, write my epitaph? and let it be: '*He fed fevers.*'"[1] Graves is generally given the credit for having established the practice of liberal feeding in fevers. When one looks over the dietary of Stokes, however, it is seen that it was more of a revolution in name than in deed, and somewhat resembled the efforts of those to-day who talk a great deal about introducing a so-called liberal diet, but who go about it with much fear and trembling, and end by advising a diet slightly different in kind and still less in degree from that ordinarily employed. Stokes advised "for the first three or four days water, weak barley-water, and whey." After that, mild nutriment was to be used, his preference being for well-boiled gruel, made of groats, with sugar and lemon-juice, also thin panada (bread, boiled in water, and sweet milk, flavored). Of the gruel and panada, a spoonful of either was given every third hour. In the middle and late stages of the fever mild animal jellies and broths, preferably chicken broth, were given. Arrowroot was also allowed. Fruits were to be avoided. Food was to be given in the daytime only and not at night. Too much drinking was not permitted. It cannot be said that this was a very liberal diet, and could hardly be called revolutionary, even if the diet had previously been purely aqueous.

With the great advance in the knowledge of typhoid fever, due to the studies of Louis, first published in 1829, the treatment was not materially influenced. Louis himself devotes very little attention to diet in his work on fever. Nathan R. Smith, who paid much attention to the treatment of typhoid fever, gave "simple diluent drinks and a very small quantity of farinaceous food." Chomel was still influenced by the phlogistic theory, and in the inflammatory form of the disease advised entire abstinence even from liquid nourishment.

Up until about 1860 the diet in typhoid did not vary largely from that introduced by Stokes. The phlogistic theory of fevers still influenced practice to some extent, and the food was mostly vegetable or farinaceous in a liquid form. Solutions or gruels of gum-arabic, barley-water, rice-water, oatmeal, Indian meal, toast and water, panada, solutions of tapioca, sago, arrowroot, vegetable jellies mixed with water,

[1] Stokes, Lectures on Fever, 1874, p. 328; Medical Times and Gazette, 1854, viii, 5.

fruit juices, etc., were employed. Milk was only allowed in the later stages, and eggs and meat extracts were employed only during convalescence.

With time, however, and the disappearance of the old phlogistic idea, milk and eggs and meat extracts came to be more and more employed. Even Liebermeister in 1874, however, was influenced by the old ideas, and states that "we must fall back then upon those nutritive substances into whose composition the carbohydrates enter largely, and thus we arrive at about the same fever diet that has been advocated by experienced physicians of all kinds since the age of Hippocrates." He *permitted* boiled milk, much diluted, and in the later stages yellow of the egg beaten up. Since this time milk, eggs, and broth have come to be more and more used, to almost the entire exclusion of the old farinaceous diet. This has been a gradual change and no one person seems to have been responsible for it, nor is there any one historic factor concerned, except possibly the gradual disappearance of the old phlogistic theory.

Just at present there has arisen considerable discussion as to the best kind of diet in typhoid fever, and a number of authorities are advocating a much more liberal diet than that at present employed. Before discussing, however, the innovations which it is proposed to make, and the theoretic reasons for so changing our practice, I will first consider the methods at present generally employed in the dietetic management of typhoid fever patients.

The usually stated requirements of a typhoid diet are that the food should be that "digested with the greatest ease and leaving behind the smallest amount of residue to form feces." There can be no doubt that in the latter requirement we have been much influenced by the knowledge of the intestinal ulceration and the fear of causing perforation. Milk has seemed to be the article best fulfilling these requirements. Next to this, pure egg-albumen has seemed most valuable. The tendency has been to simplify the feeding more and more, and the diet which has been gradually evolved on these principles is that employed in the Johns Hopkins Hospital.

Unless there is some contraindication, patients with typhoid fever are given the following diet: During the course of the fever they receive only liquid nourishment, and this they receive every two hours. This nourishment usually consists of milk alternating with egg-albumen. The amount of milk for an adult patient is 4 ounces, and this is diluted with 2 ounces of lime-water or soda-water. Alternating with milk, the patient receives the whites of 1 or 2 eggs, depending upon the size of the eggs and physicial development of the patient, the severity of the disease, etc. In general, the more serious the condition, the smaller is the amount of nourishment given. The egg-albumen is prepared as follows: A small amount of cracked ice is placed in a glass, and to this is added the egg-albumen. Now a few drops of lemon juice or sherry is added for flavoring, a little sugar is added, a cup is inverted over the glass, and the mixture is thoroughly shaken until the albumen

has been thoroughly broken up. The fluid portion is then passed into a glass through a strainer. This makes a very palatable, nutritious drink.

The great majority of patients receive this diet alone. It is only changed for the following reasons: If curds in considerable numbers appear in the stools, the amount of milk is cut down, or it may be stopped entirely; the whites of 2 or 3 eggs are then given every two hours instead. It is very rare, however, that with this amount of diluted milk, curds appear in the stools. Second, if there is such a distaste for milk that it is absolutely impossible for the patient to take it, it may be replaced by other articles. It is remarkable, however, how few patients are unable to take milk. Many will say that it is impossible for them to take it, but if it be urged and insisted upon, and given as a routine, it is usually taken without difficulty, often even with relish. If, however, patients absolutely refuse to take plain milk, it may be replaced by buttermilk, or a small amount of coffee or tea may be added. Whey may be employed and is usually well taken, but it must be remembered that this contains very little of the nutritious portion of the milk. In rare cases other articles of diet are added to the milk and eggs, though this is exceptional. Such articles are ice-cream, tea and coffee, cocoa, bouillon, and clear soups.

The above diet combines "simplicity, efficiency, and cheapness." It is undoubtedly, in the amounts given, the most easily absorbed diet possible and leaves very little fecal residue. It must be admitted, however, that its energy-producing power is low. Taking 24 ounces of milk as the average amount received, the number of calories furnished by the milk is only 485, while, taking the whites of 12 eggs as the usual number given, the calories supplied by these are only about 300, making a total energy-furnishing value of the diet less than 800 calories. Milk and eggs, however, form complete foods; that is, they contain proteins, fats, carbohydrates, and mineral salts. For the adult in health, however, they do not supply the ideal diet on account of the deficiency in carbohydrates.

What are the advantages of such a diet?

(1) With such a diet gastro-intestinal disturbances are reduced to a minimun. If the bowels are let alone, patients on such a diet are less likely to have diarrhea, abdominal pain, or tympanites than patients on a more liberal mixed diet. This statement, however, is very difficult to establish by statistics or to solve experimentally. It is based mainly on the experience of the leading clinicians of America, England, Germany, and France, where this diet, with slight modifications, has been mainly employed during the past few decades.

(2) The nervous manifestations associated with the taking of food are much less with this routine diet than when the food is being constantly changed, or when all sorts of articles of food are being tried. Typhoid fever patients are always emotional, and the less they think about their food the better. Experience shows that as soon as one begins to gratify the typhoid fever patient's whims, everything is in a turmoil, including the patient, doctor, nurses, and family. As long as a definite routine is established and maintained, the patient expects nothing else

and all moves along serenely. There is no other disease where routine is so important as in typhoid fever. The nearer the typhoid fever patient's life approaches a purely vegetative one the better. During the febrile period very few patients desire more food or want solid food. It is only in convalescence that difficulties are likely to arise, and this lasts but for a few days, and, with tact on the part of the doctor, most patients are tided over this period with very little disturbance.

(3) The danger of perforation is less. This is probably the least important reason for giving a restricted, purely liquid diet. It would certainly seem, however, theoretically, that the quieter the small intestine is kept, the less fermentation there is induced, and the less fecal accumulation there occurs, the less danger there will be of perforation. Statistics collected by Kinnicutt[1] would not seem to bear this out, however. In the Johns Hopkins Hospital, among 500 cases of typhoid fever there have been 43 or 2.86 per cent. perforations, a high percentage as compared with the statistics of certain other American hospitals as collected by Kinnicutt—higher than in certain places where a liberal mixed diet has been employed. In the statistics given by Kinnicutt, however, with the exception of the statistics from the Kief Military Hospital in Russia, where on a liberal mixed diet the cases of intestinal perforation were very few, the differences, as regards perforation, between the hospitals where the very much restricted diet was employed and those where more liberal diet was used, are not very striking. The number of cases in which a fairly liberal diet has been employed is still too few to draw any accurate conclusions. It is hard to believe that a high percentage of intestinal perforations in the Johns Hopkins Hospital could be *due* to the restricted feeding alone. It is not likely that diet alone can explain the fact that in the Massachusetts General Hospital, among 231 cases on a milk diet there were only 0.4 per cent. of perforations, while among 241 cases on a liberal mixed soft and solid diet there were 3.3 per cent. of perforations. Certainly in different epidemics and at different times, the proportion of cases showing intestinal perforation differs markedly, without obvious cause. Thus, of Curshmann's Leipzig cases (1626 patients), 2.2 per cent. had perforations, while in Hamburg, among 4094 patients, the proportion was 1.6 per cent. The importance of statistics taken from the fatal cases would be of much more value as showing the effects of diet. In such statistics as are available, however, the proportion of cases with perforation does not differ very markedly in the different hospitals. Possibly one reason why there has apparently been such a large proportion of cases with perforation in the Johns Hopkins Hospital, is the fact that a great deal of attention has been paid to perforation here during the past years, almost all suspected cases have been operated upon; and then, too, the proportion of fatal cases on which autopsies are obtained is high. The statistics given by Bushuyev from the Kief Military Hospital, where, among 318 cases of typhoid fever, only 0.1 per cent. of the cases had intestinal perforations, are certainly difficult to explain, and impossible to explain on the basis of diet alone. In this series and the series from

[1] Boston Medical and Surgical Jour., 1906, clv, 1.

the Massachusetts General Hospital, given above, the percentage is much lower than in any other statistics of which I have knowledge, and I cannot offer any explanation.

(4) This method has had almost universal approval during the past two decades. While we must not be unduly influenced by this, since traditions sometimes lead us into error, nevertheless, experience must be of considerable value. The opponents of the method claim that more liberal feeding has never been thoroughly tried, so that we are in no position to judge of the relative value of the two methods.

Certain writers go still further in the restriction of food than is indicated by the above diet-list. Many clinicians hold the view that typhoid fever patients are overfed rather than underfed. There are still a number of physicians who employ a strict water-diet with apparently considerable success. In this country certain physicians give their patients no food whatever from the commencement of the disease until the temperature is normal.

On the other hand, a number of clinicians, both in this country and in Germany, and also in France, have lately been advocating a much more liberal diet, consisting of both liquid and solid food. All kinds of diet have been advocated, from those which are only slight modifications of the milk-albumen diet to those which include all sorts of meat, vegetables, etc. The reasons given for this change are somewhat as follows:

(1) It is argued that the marked loss in weight and strength from day to day indicates that the amount of food usually given is not sufficient to replace the loss due to the excessive tissue metabolism; that the need for nourishment in typhoid fever is greater than that normally present. Taking the energy expenditure of a normal person at rest at 2300 calories, and allowing 500 calories additional as the increased expenditure associated with the fever, the total expenditure is calculated at about 2800 calories. It is claimed that to guard the body tissues from loss, food having an approximate energy value equal to the above should be given. It is generally believed, however, that it is impossible entirely to replace this destruction of tissue in fever, that in spite of a great excess of food there is a constant loss in body weight, but by increasing the food this loss can be diminished. From a study of metabolism experiments so far done, Nichols concludes that this necessary loss of protein and fat is an amount which, on combustion, would yield about 800 calories. Therefore, it is argued that the food should have an energy-supplying value of at least 2000 calories. To supply this by milk alone would require at least 3 liters, an amount impracticable to give, on account of the bulk and the excessive formation of curds in the stomach and intestines thereby produced.

(2) With the increased diet the comfort of the patient is greatly promoted. It is urged that the withholding of food causes a great deal of suffering which is entirely unnecessary.

(3) Intestinal complications are no more frequent with such a diet than with the liquid diet. As Müller points out, the larger amount of

meat is absorbed in the upper part of the intestines, and it is hard to see why the softer forms of solid food would be more likely to cause perforation and hemorrhage than would the curds of the milk. It is stated that intestinal fermentation, tympanites, and diarrhea are no more common with a mixed diet than with the purely liquid one; also that the fecal residue is no greater with a carefully chosen solid diet than with the one usually employed. Statistics have been adduced to show that intestinal perforation and hemorrhage from the bowel are no more common with the solid diet. We have already considered the question as to perforation. Kinnicutt has collected 733 cases on a liberal diet, in which 4.77 per cent. of the cases had hemorrhage, while in 411 cases, on a fluid diet, 8.33 per cent. of the cases had hemorrhage. The same remarks which were made in regard to the influence of diet on perforation, however, seem to me to hold in regard to hemorrhage. Further statistics will have to be obtained before we can consider this matter as settled. It must be admitted, however, that the evidence so far does not seem to show that these complications are especially induced by semi-solid or solid food. Friedrich Müller, of Munich, has advocated a more liberal diet, the details of which are given below, and among 87 patients on such a diet, he has not seen a single case of perforation or hemorrhage.

(4) It is claimed that with patients on such a diet the convalescence is shortened, relapse is no more frequent, if as frequent, the postfebrile subnormal temperature is avoided, and, lastly, the mortality is no greater. In support of this last statement, Nichols has collected 1000 cases in which the patients were given an increased diet, with but 77 deaths, 7.7 per cent.

Of the authorities in this country advocating a liberal diet, Shattuck, of Boston, has probably been the foremost. The dietary employed by him, in the Massachusetts General Hospital, consists of:

(1) Milk, hot or cold, with or without salt, diluted with lime-water, soda-water, Appollinaris water, Vichy; peptogenic and peptonized milk; cream and water, milk with white of egg, slip buttermilk, kumyss, milk whey, milk with tea, coffee, cocoa.

(2) Soups: beef, veal, chicken, tomato, potato, oyster, mutton, pea, squash, carefully strained and thickened with rice (powdered), arrow-root, or flour, milk or cream, egg, barley.

(3) Horlick's food, Mellin's food, malted milk, carnipeptone, bovinine, somatose.

(4) Beef juice.

(5) Gruels; strained cornmeal, crackers, flour, barley-water, toast-water, albumen-water with lemon juice.

(6) Ice-cream.

(7) Eggs, soft-boiled or raw, egg-nog.

(8) Finely minced lean meat, scraped beef; the soft parts of raw oysters, soft crackers with milk or broth; soft puddings without raisins; soft toast without crust; blanc mange, wine jelly, apple-sauce, and macaroni.

In England the liberal dietary which has been most generally employed is that used by Marsden in the Monsall Fever Hospital. In mild cases this consists of bread and butter, milk with custard, fish with mashed potatoes, chicken and minced meat. He has employed this diet, however, in a very restricted manner, as a study of his cases shows that in only about half of them was the solid food given before defervescence of the fever.

In Russia, Bushuyev has advised a more liberal diet consisting as follows:

7 A. M.—Tea with a roll.

8 A. M.—Soft (liquid) oatmeal, barley, or wheat porridge (400 cc.) with butter.

9 A. M.—One or 2 boiled eggs, soft or hard, as the patient desires.

10 to 11 A. M.—A glass (200 to 220 cc.) of milk with a roll, one-half a cutlet, and a bit of boiled meat (160 to 168 gm.).

12 to 12:30 P. M.—A plate (200. cc.) of chicken soup or a bowl of ordinary soup, sometimes with a bit of chicken from the soup, and a small cup of "kisel" (a sort of sour jelly); rarely, a little preserved fruit.

3 P. M.—Tea with a roll.

6 P. M.—A cup of chicken or beef soup; semolina pudding or milk, a bit of chicken.

8 P. M.—Milk with a roll.

During the night—coffee or tea, with milk, two to four times; coffee with cognac.

In addition, the patients receive from 1 to 3 ounces of wine in the morning and every two hours ½ ounce of Stokes' mixture.

Lastly, in Germany, the diet advocated and employed by Friedrich Müller is still more liberal than any of the above. Besides 1 to 1½ liters of milk daily, he gives tender meats, hashed or scraped beef, brains, finely chopped veal, chicken, game, potatoes, meal or flour or rice gruel, spinach, apples, zwieback, and dry white bread. He is careful to avoid giving the tendinous portions of meat, cartilage, or the hard and indigestible portions of vegetables and fruit.

It is evident that in none of the above diets has much of an attempt been made accurately to meet the patient's total requirement for food, or to supply his relative requirements for protein, fats, and carbohydrates. Most of those who have advocated a more liberal and mixed diet have insisted that the amount and kind of food should be regulated mainly by the patient's appetite, but that, instead of restricting the amount of food, it should be urged upon him, and efforts should be made to stimulate his appetite. We feel, however, that in typhoid fever rules for feeding should be as strict as those which are laid down for the administration of medicine. When the diet is left to the discretion of the nurse and the whims of the patient, he is likely to get at a given time either too much food, or else not even as much food, as regards caloric value, as when he is given only milk and eggs, according to a strict routine. If we are to change the methods of feeding in typhoid fever, it

should be done with some definite object in view, and this should not be loosely "giving more food." In Bushuyer's diet, for instance, the total amount of energy supplied and the protein content is little, if any, greater than that of the ordinary liquid diet.

Lately, attempts have been made to determine the proper diet for typhoid patients in a more rational manner. Nichols has attempted to determine the most favorable diet as regards total caloric value, and also as regards relative proportions of protein, fat, and carbohydrate, deducing his conclusions mainly from the results of previous experimental metabolism work on animals. The data on which he bases his conclusions have been collected mainly by Atwater and Longworthy in Bulletin, No. 45, United States Department of Agriculture. From these results it is apparent that the daily nitrogen loss is least when the nitrogen content of the food equals about 17.2 gm., equivalent to 107.5 gm. of protein. As this amount of protein yields only about 430 calories, in order to supply the 2000 calories which are considered necessary, carbohydrates and fats are to be given in sufficient amounts and in a form best tolerated. Theoretically, we would be able to supply an increased total amount of energy, if this is considered advisable, simply by increasing the amount of milk and eggs.

But most writers, who have studied the question from the metabolic standpoint, agree that milk and eggs alone do not form the best diet, since, to supply a considerable amount of energy, very large amounts of milk are required, which is a practical objection, and the giving of large amounts of egg albumen is not advantageous on account of the high protein content. Rubner has shown that in the fasting individual protein alone must be given in extremely large amounts to maintain nitrogenous equilibrium, on account of its effect in increasing total metabolism (specific dynamic effect). Rubner also found that in dogs the heat production might be increased 60 per cent. solely by feeding them large quantities of protein food.

It has been shown, however, by Lusk and others that carbohydrates have a high value in sparing body proteins in afebrile conditions. Carbohydrates alone may reduce the amount of nitrogenous excretion by 50 to 70 per cent. of the starvation excretion (Schaffer and Coleman). Fat does not have this protein-sparing function, though it does spare the body fat. It would, therefore, seem that if carbohydrates have this same function in febrile conditions, we could best prevent the loss of body protein by giving food of high carbohydrate content, and, to overcome the increased loss due to the elevated temperature, the food should have a very high caloric value. It would thus, theoretically, seem that possibly the protein loss in fever could be entirely overcome. Schaffer and Coleman have made extended investigations into this question, which have yielded results which may be of the greatest significance in the methods of feeding in typhoid fever. Their careful metabolic studies on 7 cases of typhoid fever seem to show that in typhoid fever there is an increased need for carbohydrates, and unless the food contains sufficient carbohydrate to compensate for this increased demand, the body protein

is drawn upon, but that if the food contains sufficient carbohydrate for this increased demand, the body protein is protected. Their experiments also seem to show that nitrogenous equilibrium in typhoid fever may be maintained by the administration of food containing 10 to 15 gm. of nitrogen in addition to much carbohydrate, but that there is no advantage in increasing the protein content of the food over this amount. This is a somewhat less amount of protein than was considered advisable by Nichols. But in the experiments from which his deductions were made, there did not occur the same attempt to replace the nitrogenous food by carbohydrates. In the attempt of Schaffer and Coleman to increase the amount of carbohydrate administered they made use of large amounts of milk sugar. The amount necessary to provide a sufficient number of calories was from $\frac{1}{2}$ to $1\frac{3}{4}$ pounds per day. It would seem that the practical difficulties in getting a patient to take this amount of milk-sugar would be almost unsurmountable, though Coleman[1] has given this method of feeding in 46 cases, and maintains that it can be carried out without great difficulty. He states that a patient of 150 pounds weight should receive food equivalent to 4000 calories or more a day.

The daily diet advised consists of about $1\frac{1}{2}$ quarts of milk, from 1 to 2 pints of cream, from $\frac{1}{2}$ to $\frac{2}{3}$ pounds of milk-sugar, and from 3 to 6 eggs. In addition, the patient is allowed small slices of stale bread or toast, with as much butter as he wishes. It will seem that in this dietary the increase in caloric value over that of the ordinary milk and egg diet is obtained by the addition of cream and large amounts of milk-sugar. The attempt to appease the patient's appetite by an extensive varied dietary is, therefore, left entirely out of consideration.

The value of this diet must ultimately rest on the results obtained. Of 46 patients so fed by Coleman, only 1 died, and all the others left the hospital in excellent condition. I have had no personal experience with this method of feeding, but it seems to be founded on good theoretic considerations. The objections to be urged are that it might be expected that the amounts of milk-sugar given would cause digestive disturbances and would predispose to tympanites. Coleman states, however, that this is not the case, and, moreover, that the milk-sugar did not exhibit the laxative properties which have been ascribed to it.

If, however, the main reason for increasing the diet in typhoid fever is based on the desire to make it more palatable, and, therefore, better absorbed and digested, the experiments of Schaffer and Coleman will have little value. This has certainly been the main object of most of those who have advocated a more liberal diet. If this is the only reason, it seems that by varying the methods of preparing the eggs and milk, by making thin custards, etc., much would be accomplished. It is doubtful, however, whether the results to be obtained in greater comfort to the patient justify such modifications, for we have found that, even with such slight modifications in the diet, digestive disturbances are more likely to occur than with the simple egg-and-millk diet. Those who advocate the use of solid food must remember, that since, at the present,

[1] Jour. Am. Med. Assoc., 1909, liii, 1145.

the weight of authority is on the side of fluid feeding, they must show not only that patients are not harmed by solid food, but that their chances for recovery are increased. We have much more sympathy, however, with efforts like those of Schaffer and Coleman, in which the prevention of tissue loss is kept strictly in mind, and in which the diet is kept as simple as is possible. Of course, it is possible that with great care a dietary more varied might be arranged, affording similar food values. But if it is simply a matter of gratification of the patient's appetite, each one will have to decide for himself how far he is justified in going. One must remember that the main object which we must keep constantly before us is the overcoming of the infection; and the state of nutrition of the patient in itself, and whether convalescence is slightly prolonged or not, are of little or no importance. With our present vague ideas as to how the infection is overcome, it is impossible for us to say whether the nutrition of the patient plays any part at all. Certainly, as regards infection, we know that the healthy, strong, and well nourished are just as likely to be attacked as the underfed and puny. Moreover, it is a matter of common observation and general belief that the prognosis in typhoid fever in the fat and well nourished is less favorable than it is in the thin.

The advisability of the employment of a more varied diet in typhoid fever must be decided at present on practical and not theoretic grounds; for, as we have said, the knowledge of metabolism in fevers is not yet sufficiently accurate for us to draw definite conclusions from experiments, which at best can only deal with a very limited phase of the question. The fact, however, that a more liberal diet is now being employed by so many thoroughly trustworthy and experienced clinicians is certainly justification for those who desire to try this method more fully. It is argued by those that advise a mixed diet that the method has not yet been employed sufficiently for definite conclusions to be drawn, but that, so far, it cannot be claimed that the results are unfavorable. There can be no doubt that suddenly changing the amount of food will cause elevations of temperature (*febris carnis*). It is claimed that such elevations of temperature are due to the *sudden changes* in diet and not to the amount of food in itself. This should be borne in mind by those who undertake this method of feeding, and it is very important that it should be carried out, when once undertaken, consistently, and not "by fits and starts." There can be no question as to the increased difficulty of such a method of feeding, and the physician undertaking it should fully realize his responsibility in the necessity for leaving accurate directions daily, or oftener, as to exactly the kind and amount of food desired. Certainly, nothing can be gained by giving a list of permissible articles to the nurse, and permitting her to give to the patient whatever seems desirable or convenient, or permitting her to consult with the patient before each nourishment as to what he desires. We should keep in mind constantly, if we decide to carry out this liberal method of feeding, what we desire to do.

We may conclude that the diet of typhoid fever patients should be

changed from that ordinarily employed only after deliberation, and at present such changes must be regarded as experiments, justifiable only by those who are able to carry them out in a manner to obtain trustworthy results. We must constantly keep in mind that there are two distinct problems: first, the giving of solid food and a varied diet in order to make the patient temporarily more comfortable, and, second, the giving of increased amounts of food constituents in order to reduce or prevent tissue loss. From Schaffer and Coleman's work it would seem that it may be possible to do the latter with a simple diet, and at the same time run no additional risks of digestive disturbances.

Even when we employ simple articles of diet like milk, we must always have before us the necessity for seeing that such food is fresh and of the best quality. Edsall has pointed out the dangers which may arise when milk is not perfectly fresh and uncontaminated. Where the diet becomes so complex, as it is advised by certain writers to make it, the necessity for this careful observation becomes much greater and more difficult, but cannot be overlooked, on account of the great susceptibility of typhoid fever patients to digestive disturbances and because of the harm which may be induced by such gastro-intestinal complications.

Water.—Even though it was early recognized that "it is easier to fill up with drink than food" (Hippocrates), the old view that water in fever was harmful was long in the ascendency. At all periods, however, there have been physicians who advocated giving large amounts of water, and to-day the pendulum has swung to the extreme, and, instead of not only letting patients have as much water as they desire, it is urged upon them, and the attempt is made to have them take as much as possible. Water is an essential element of food, and, while experiments seem to show that in fever there is really a water retention, this is very difficult to determine accurately on account of the loss of moisture through the lungs. Experiments show that the ingestion of water increases the digestion and absorption of food. Possibly the most important reason, however, why it is advisable to give large amounts of water is that in this way all the excretions are stimulated, and it is hoped that the toxins are eliminated together with the increased amount of sweat and urine. When given cold in large amounts it also acts as an antipyretic. At the Johns Hopkins Hospital it has long been recognized that typhoid fever patients who drank large amounts of water got on better than those who were unable to drink freely. This was especially noticeable in the relatively favorable course in private patients having special nurses, who could devote a good deal of attention to giving them much water to drink. To Dr. Cushing, of Cleveland, however, great credit is due for having pointed out the necessity for giving very large amounts, and of showing that this could be successfully accomplished in the public wards of hospitals. Cushing and Clark[1] insist upon the necessity not only of giving the patients as much as is willingly taken, but of urging it upon them at all times. It was found that where the drinking of water is pushed, typhoid fever patients can take

[1] Amer. Jour. Med. Sc., 1905, cxxix, 187.

enormous amounts in twenty-four hours, and these large amounts apparently do no special harm. Neither at the Lakeside Hospital, in Cleveland, nor at the Johns Hopkins Hospital have any unfavorable symptoms resulted from this practice; even where the amount of urine is enormously increased (24 liters in one day in a case at the Johns Hopkins Hospital) no deleterious effects upon the kidneys have been seen. At present the rule is to have the nurse give the patient water every half-hour, as much as he can take. Occasionally patients rebel at the frequent dosage, but this is unusual, and if the doctor constantly urges upon them the importance of taking large amounts of water, they often become exceedingly interested and helpful, and watch the record of the amount of water they have taken daily with much interest. Patients are frequently admitted, who during the first twenty-four hours void not over 10 or 12 ounces of urine, but by the second or third day this is enormously increased. Cushing points out that as soon as the nurses found that the increased amount of water reduced the number of tubs required, they became still more enthusiastic in its administration, and the possibility of reducing the number of tubs by this means should be urged both upon the patient and the nurse. Cushing thinks that not only are the nervous and intestinal symptoms diminished in severity but also the complications are less frequent. He feels also that the mortality has been reduced, as in 100 cases where the patient voided above 100 ounces of urine, the mortality was only 5 per cent., while the mortality in all the cases, 373, treated during the year 1903, when no special attention was given to the administration of water, was 10.2 per cent. It is very difficult, however, to judge of the effects of any one form of treatment from the mortality in a small number of cases, and further statistics will have to be obtained before this can be decided. My own feeling is that the severity of the symptoms is certainly lessened when the patients take large amounts of water, and that there is no limit to the amount which should be urged upon them. The practice of allowing the patients to help themselves to water, even from a cup placed at the bedside, or, as we have tried, according to the plan advised by Cushing, allowing the patients to draw the water through a tube from a bottle placed beside the bed, we do not consider advisable. It adds a source of unnecessary exertion on the part of the patient, and, where the nursing staff is adequate, it is advisable that water be administered by the nurse as a routine and at very frequent intervals.

Treatment Directed Against the Germs.—*Intestinal Antisepsis.*—With the discovery of the intestinal lesions of typhoid fever it was at first thought that this disease was simply a special form of enteritis, that the main treatment should be directed toward the healing of these lesions, and that the poisons to which the symptoms were due were produced mainly by bacteria growing within the intestinal lumen. With further work on the pathology of the disease, however, and our present knowledge of the wide distribution of the bacilli throughout the body, it has come to be recognized that the intestinal lesions represent only one relatively unimportant factor in the disease, and that typhoid

fever is really a septicemia; also that the symptoms of the disease are due very slightly, if at all, to the absorption of toxins from the intestinal canal. Notwithstanding these facts, various attempts have been made, and are still being made, to treat typhoid fever by treatment of the local lesions and by attempts to render the bowel sterile. At the present day most persons know that it is absolutely impossible to render the bowel sterile by any means at our command. The advocates of the antiseptic method claim, however, that while they realize this fact, they believe that the degree of fermentation and the amount of bacterial growth going on in the intestinal canal can be diminished by the use of antiseptics given in such amounts as not to harm the patient. The chief support offered for this view is that, after giving certain of the so-called intestinal antiseptics, the stools become less foul smelling. Drugs making up a long list have been proposed to produce this diminution in intestinal fermentation, and not a year passes that some new drug is not proposed, serving as the basis for a so-called new method in the treatment of typhoid fever, which method invariably receives extensive trial by the introducer and his followers, and at first meets with very laudatory commendation from various sources; but it has been the history of all these so-called cures that after a time the unfavorable reports begin to appear, the method drops into disuse, and is heard of no longer. Among the drugs which have been employed have been bismuth, turpentine, salol, oil of cinnamon, calomel, eucalyptol, thymol, guaiacol carbonate, carbolic acid, iodin, salicylate of bismuth, sulphocarbolate of zinc, acetozone, naphthalin, formaldehyd, etc. With certain of these drugs the good effects have been due probably to the large amount of water with which it has been advised the drug should be administered. This is probably the case with acetozone. Certainly the power of all these drugs, in the doses advised, in rendering the intestines antiseptic, is slight, if any, and I feel that they have no place in the treatment of this disease.

A modification of this method is that described by Ewart.[1] He proceeded from the view that before any antiseptic action on the ulcers or walls of the intestines is possible, it is first necessary to disinfect the fecal matter contained within them; and, recognizing the impossibility of rendering the feces sterile, he has attempted to keep the bowels empty by the administration of 2 ounces of castor oil every morning in case the bowels fail to act every day, and he has tried to prevent the formation of feces, so far as possible, by the regulation of the diet. This he does by the administration of whey, eggs, vegetable and fruit juices, jellies, sugar, and cream only. He also gives liquid paraffin, 2 teaspoonfuls every four hours, with the object of supplying a protective layer to the ulcers, and he also administers vegetable charcoal, 2 teaspoonfuls every four hours, with the object of absorbing the poison and of preventing intestinal fermentation. While I believe that the principle of keeping the bowels as free from feces as possible is the correct one, and that this can best be accomplished by the use of a proper diet, the hope of forming a

[1] Brit. Med. Jour., 1905, ii, 1501.

coating for the ulcers by the use of liquid paraffin is one which it is hopeless to think of attaining. I also feel that the effect of the charcoal will be mainly to cause constipation and necessitate the use of purgatives, which I believe are to be avoided if possible.

The drug which has probably been most extensively used and for the longest time, with the idea of intestinal antisepsis, is calomel. At first it was employed for its purgative action, but, with the discovery of the great antiseptic properties of bichlorid of mercury, a second reason for its administration was urged, and with the support of such clinicians as Liebermeister and von Ziemsson it received a most general employment. Even so late a writer as Curshmann, owing mainly to the recommendation of these writers, does not advise against the employment of this drug. However, he is not very enthusiastic in regard to this method, and concludes "that it is justifiable for the present to assume a doubtful attitude toward the antiseptic method, and even one of skepticism with regard to the hope that it may in future prove more successful." I can only fully agree with him and support this view.

General Antiseptics.—From time to time various drugs are heralded as cures of septicemia. Such drugs, by specific action, are thought to influence materially the growth of bacteria within the body. These drugs have been recommended to be given either by the mouth, hypodermically, or even intravenously. They have usually been bactericidal substances, but of necessity have had to be given in doses which would be entirely inadequate to produce any effect outside of the body. They have been supposed to act within the body in some mysterious way, and all sorts of bizarre theories have been advanced to explain their action.

Quinin, owing to its anti-malarial effects, has been most largely employed as an anti-infectious agent, and even to-day is employed to a considerable extent with this idea in view. Experiments have shown, however, that bacteria are very much more resistant to the action of quinin than are the protozoa, and, to have any effect on bacteria within the body, such large amounts of quinin would have to be administered as to almost certainly produce poisoning. The same may be said for the various silver preparations—collargol, etc.—which of late years have had most enthusiastic advocates.

Without discussing further the various drugs which have been used for this purpose, I may say that we know of no drugs which directly kill or inhibit the growth of bacteria within the body. The only forces of which we have knowledge, and these only by the effects, are the natural resisting forces of the body, and there is no evidence at present to show that these are materially increased by the administration of minute doses of bactericidal substances.

Treatment Directed to the Elimination of Toxins.—I have already spoken of the use of large amounts of water by the mouth as probably having a marked effect on the elimination of the poison of this disease, and I also consider this to be one of the effects of external hydrotherapy. A third method of hydrotherapy has been employed with this same end in

view—namely, rectal irrigation. While I feel that the use of an occasional rectal enema for the purpose of washing out the lower bowel and of preventing the accumulation of feces is of value, I do not think that the routine practice of giving frequent rectal injections, several in one day, is to be advised. If there is one fact established in regard to the treatment of typhoid fever it is that the quieter the intestines are kept the better, and these frequent irrigations are more likely to cause increased intestinal peristalsis than to quiet it. The hope of washing out accumulated toxins in the lower bowel in this way is a purely hypothetic consideration, as there is no evidence at present that the specific poisons of this disease are formed within the intestinal canal, so that the necessity for frequent rectal lavage is no more present in typhoid fever than it is in pneumonia or in any other acute infection. If any good results from this method, it is probably due more to the fluid which remains in the bowel than to the direct removal of poisons.

When the patients are unable to take large amounts of fluid by the mouth, and other methods of introducing fluid into the body are not considered advisable, we may consider the frequent employment of small enemas of salt solution for the purpose of introducing fluid into the system in this way. Such enemas should not be larger than 400 or 500 cc. They should be allowed to flow in slowly, and, if there is no marked rectal irritability, they may be repeated two or three times during the day. A more satisfactory method, however, for introducing fluids into the rectum is by means of a continuous irrigation through a small rectal tube or catheter passed high up in the bowel. The liquid is allowed to flow in slowly and continuously, and in some patients this is well absorbed and proves a very efficacious method for the introduction of fluid.

In patients who will not drink sufficient water, or are so toxic that they will not swallow, or for other reasons refuse to take a sufficient amount of fluid, it is quite justifiable to pass a stomach-tube two or three times during the twenty-four hours, and through this to introduce each time 500 to 750 cc. of water. This, in certain cases, has proved of value.

Lastly, where sufficient fluid cannot be introduced in any other way, it is advisable to use hypodermoclysis for this purpose. The value of this method of treatment should be regarded as due to its effect in aiding the elimination of toxins, rather than to any cardiac and vascular stimulation which it may be supposed to cause. In very ill cases, where it is important to administer as much fluid as possible, at least 2 liters per day may be administered in this way, giving it in succession under the breast, in the axilla, into the thigh, first on one side and then on the opposite one. Great care must be taken to prevent necrosis, which sometimes arises if the fluid is allowed to run in too rapidly, and it should not be given in the lumbar region, or in any place where there is likely to be pressure, on account of the great danger of decubital ulcers forming.

In desperate cases sterile salt solution may be injected intravenously. I feel, however, that this should be undertaken simply as a last resort, and if this method is employed, great care should be used to allow

the fluid to run in very slowly and to avoid all possible danger of contamination. I have never seen any very good results from this method. On the other hand, such intravenous injections, even when given with the greatest care, are not infrequently followed by chills and increased fever, which in very ill patients may be associated with disastrous results. The chills and rise of temperature seem to be idiosyncrasies in certain patients and are similar to those which occur after gelatin injections in certain individuals, or may be analogous to the fever induced in infants by the administration of sodium chlorid (Finkelstein).

The use of purgatives to increase elimination of toxins from the bowels I believe to be contraindicated: first, because purgatives in themselves do harm, and, second, because there is no evidence that toxins are eliminated in this way.

Treatment Directed Against the Fever.—*Antipyretic Drugs.*—With the discovery of certain synthetic carbon compounds, which were found to have a marked effect in lowering the temperature, especially when this is abnormally elevated, great hopes were aroused that by their administration a new method had been found for combating the specific fevers. It was soon found, however, that while undoubtedly the temperature could be lowered by these means, the course of the disease was very little, if at all, affected. Added to this, it was soon found that great harm might result from the administration of these drugs, owing to their depressive action on the circulatory system, to which action there are great individual differences in susceptibility. It must be remembered that we still know very little in regard to the essential nature of fever, and its relation to infections is also still obscure. The old question as to whether fever in itself is beneficial or harmful is not yet definitely settled. It is now recognized that the object to be sought in the treatment of febrile disease is not merely the lowering of the temperature, but is that of increasing the natural resistance to the infectious agent and to its products.

Among the drugs which have been employed for their antipyretic purposes, quinin has been used probably for the longest time and most extensively. Owing to the recommendation given to it by Binz, it has been very largely employed in Germany, and to a less extent in other countries. It has been warmly recommended by Erb.[1] He recommends quinin hydrochlorate, 1.5 to 2 gm., to be given in the evening in two doses in succession. Following this there occurs a fall of temperature which lasts the entire next day and second night and morning. As on the second day the evening temperature again becomes elevated, it is necessary to repeat these doses every second evening. He advises giving it not in the early stages, but beginning only in the latter half of the second week. He considers that it has not only an antifebrile effect but also acts favorably on the course of the disease and shortens its duration.

The explanation of the antipyretic action of quinin, as given by Binz, is that it is due to a direct action on the tissues, lessening nitrogen-

[1] Therapie der Gegenwart, 1901, p. 49; quoted by Klemperer, Deutsche Klinik, ii, 520.

ous metabolism. It would, therefore, theoretically be the best antipyretic drug to use in case it were advisable to employ such measures. Cushny states that its action is more marked when the temperature is falling, as after the employment of cold tubs or other antipyretic measures, than it is when administered during a rise of temperature.

Long lists of carbon compounds have been employed for their antipyretic effects, and hardly a month passes that a new one is not introduced by one of the pharmaceutic factories. Antipyrin was one of the first of these drugs employed, and, while markedly antipyretic, its action is very frequently accompanied by collapse and by changes in the blood. Antifebrin or acetanilid has the same objection. Phenacetin seems to have these unfavorable properties less well marked, but still cannot be considered a perfectly safe drug to use in doses sufficient to cause marked lowering of the temperature. Lactophenin, salophen, and a long list of similar drugs have been employed.

A drug of this group employed to a large extent, especially in France, is paramidon, which, in addition to its antipyretic effect, is claimed to have an eliminative and diuretic action as well. Sabarthez reports only 1 death among 85 cases treated with this drug. We must remember, however, that similar statistics have been reported with practically every one of the antipyretics introduced, and doubtless this will continue.

Guaiacol and guaiacol carbonate had a great vogue a few years ago. When applied to the skin over a wide area they produce a marked fall of temperature, which is usually abrupt, and is accompanied by symptoms of exhaustion, weakness, and sweating. The effect is only temporary, however, and the temperature soon rises again. Cushny explains the fall of temperature as due to absorption of the drug, and regards it as a symptom of poisoning. He thinks that possibly the irritation of the skin may also produce a reflex action on the vasomotor nerves. In the treatment of typhoid fever it is usual to paint 10 to 15 drops on the thigh whenever the temperature rises to a certain level. Unless the chemical employed is pure, there is danger of its setting up marked irritation of the skin. The employment of this drug at present is very much less than it was a few years ago.

According to Cushny, "all of these coal-tar derivatives probably owe their action to the formation of simple derivatives of paramidophenol in the tissues, and differ chiefly in the rapidity with which this decomposition occurs. A rapid formation of paramidophenol produces destructive blood changes and a tendency to collapse, while the antipyretic effects pass off very rapidly. Those drugs are found most satisfactory antipyretics in which the decomposition proceeds gradually, so that the temperature falls slowly and remains low for a longer time. The simpler antipyretics, such as antifebrin, have given way largely, therefore, to the phenetidin compounds." He concludes that "the antipyretics reduce the temperature in fevers through alterations affected in the heat-regulating nervous mechanism, resulting in lowering the point at which the temperature is maintained. As a result of this action, a great

increase in the dissipation of heat must occur in order to free the body from the warmth which it has accumulated, and this increased output is attained by the dilatation of the cutaneous vessels. When the temperature is depressed too rapidly by these remedies a condition of collapse is often produced, while in other cases the loss of heat caused by the dilatation of the skin vessels seems to be excessive, and shivering and rigors follow in order to increase the production."

We may say, in conclusion, that so far no drug has been found whose antipyretic effect is superior to that which may be obtained by the use of hydrotherapy. On the other hand, hydrotherapeutic measures directly produce good effects in stimulating the central nervous and vascular systems, on which most of the drugs employed for this purpose have a direct depressive action. While the administration of hydrotherapy requires more effort on the part of the physician and nurse, I feel that the benefits to be obtained, and the freedom from the danger which is always present when these drugs are employed, is more than sufficient to justify this extra labor and to leave no excuse for the employment of these dangerous drugs. Even though an antipyretic drug should be discovered free from these unfavorable characters, it is doubtful whether it would be of any use in the treatment of typhoid fever. Probably the good effects of hydrotherapy are very little, if at all, to be ascribed to its temperaure-lowering action. If for any reason it were absolutely impossible to use hydrotherapy in typhoid fever, I would feel, with the German clinicians, that quinin is the best drug to be employed. An occasional dose of phenacetin will probably do no harm and, where hydrotherapy cannot be used, may add to the patient's comfort, but I do not think that its routine employment is justifiable.

Hydrotherapy

Historic.—The introduction of external hydrotherapy, sponging, cold baths, etc., as a procedure in the treatment of fever is usually given as of comparatively recent date. While its extensive, almost universal, application, as at present, has only been developed in the past century, nevertheless there have been physicians ever since the time of Hippocrates who have used this method in the treatment of fevers and have urged its value upon their colleagues. It is related that the practice of cold bathing in fevers was introduced at Rome in the infancy of the methodic sect. The Emperor Augustus was attacked by a fever, probably of a "bilious remitting kind," and after a thorough trial of the ordinary remedies and of warm bathing, no improvement having taken place, his physician, Antonius Mufa, prescribed the cold bath, with such excellent results that it became extensively employed. As shortly afterward, however, its employment in the case of Marcellus, presumptive heir to the Empire, proved unfortunate, it soon fell into disuse.

The credit for the introduction of hydrotherapy is usually given to the Liverpool physician, James Currie.[1] Apparently, however, a number

[1] Medical Reports on the Effects of Water, Cold and Warm, as a Remedy in Fever and Febrile Diseases, etc., James Currie, M. D., F. R. S., Liverpool, 1795.

of physicians at this time were independently employing this method. On this continent, Robert Jackson extensively employed cold bathing in the treatment of fevers from 1774 to 1782. He states that "cold bathing, indeed, is the remedy on which we must principally depend. There are others which do good occasionally, but this is the only one I know which has any very considerable effect in changing the nature of the disease. . . . I met with no example where the boldest use of it did harm." Nathan R. Smith was also a strong advocate of the use of hydrotherapy,[1] and states in his essay on typhus fever, first published in 1824, that "the most effectual method of reducing the temperature of the body is by the use of cold water, which may be taken internally or applied externally. When persons sick of this disease desire cold water to drink it should never be denied them—they should be allowed to drink of it *ad libitum*. . . . The only effectual method of cooling the body in these cases is by the use of cold water applied externally; by this means we can lessen the heat to any degree we please. Different physicians have adopted different modes of making the application. . . . The method which I have adopted is to turn down the bedclothes and to dash from a pint to a gallon of cold water on the patient's head, face, and body, so as to wet both the bed and the linen thoroughly. . . . As soon as his linen and bedclothes begin to dry, and the heat in the head and breast begin to return to the surface, the water should again be applied. . . . It is not very material what the temperature of the water is if it is below blood heat, excepting the shock given by its first contact, which in cases where there is much stupor or coma is of some importance." It is thus seen that the chief advantages in the use of cold water were thoroughly recognized and the method was extensively employed by him. It seems, therefore, that he does not obtain all the credit which he deserves in the advocacy of this procedure. The method, also, in the early part of the last century was employed by Cullen and other English physicians.

The introduction of the method in its present form, however, we owe largely to E. Brand, of Stettin,[2] who strongly urged its advantages in numerous publications and insised upon its routine employment in all cases, mild as well as severe. The method in a more or less modified form is now almost universally employed. Its *routine* employment, however, in the exact form as advised by Brand has not received the universal application which I feel it deserves.

Methods of External Hydrotherapy.—There are various methods which have been used for the application of cold water to the exterior of the body, and much of the success depends upon the manner in which the various methods are administered. I will take them up individually in some detail.

Tubbing.—Much of the success of bathing in typhoid fever depends upon the manner in which the "tubs" are given, and with the best arrangements and appliances, with nurses who have had thorough training

[1] Medical and Surgical Memoirs, Nathan Smith, M. D., Baltimore, 1831.

[2] Die Hydrotherapy des Typhus, Stettin, 1861; Zur Hydrotherapy des Typhus, Stettin, 1862; Die Heilung des Typhus, Berlin, 1868.

in proper methods, much more can be expected and accomplished than where one has to make use of inadequate facilities. This, however, should not deter one from using the method, as excellent results may be obtained even in the most unfavorable surroundings and with the most crude makeshifts. Outside of hospitals, a great deal depends upon the cleverness and skill of the physician in devising methods to meet the special conditions.

I will first discuss the ideal method, and then briefly the methods to be used where it is impossible to obtain the best appliances.

Baths.—In a few hospitals, where special wards have been set aside for the treatment of typhoid fever patients, permanent tubs have been built at the ends of the wards. A stretcher on wheels on which the patient may be placed is employed, and so he is moved from the bed to the stationary tub. At the Pennsylvania Hospital a crane is used by which the patient on the stretcher is lifted and allowed to sink slowly into the tub. While there are some advantages in this permanent tub, such as having constantly at hand a full supply of hot and cold water, so as to be able to change the temperature of the water instantly, there are certain manifest disadvantages. The wheeling of the patient from one end of the ward to the other, even if only for a short distance, and even if it can be done without any jolting, is always sufficient to cause in him a certain amount of alarm and temporary anxiety and excitement. It would be far better in wards intended for typhoid fever patients to have water-pipes running along the walls, with faucets for hot and cold water at the head of each bed, so that if necessary water could be added to the tubs *in situ*. I know, however, of no wards at present with such arrangements. In any case, however, the usual portable tub offers very marked advantages; even if it were possible to fill the tub at the bedside of the patient, it is better to have the tub filled outside the ward with water at the proper temperature and wheeled to the bedside for the following reason: It is very important that the patient be not disturbed until all the preparations for the bath are complete; and after the patient becomes aware that a tub is to be given as little time as possible should elapse before he is in the water. Often the apprehension is much more disagreeable than the tub itself, and the practice of nurses in beginning the preparation of the patient for the tub a half-hour before it is intended to be given, or allowing the tub to be wheeled to the bedside before the patient is ready, is to be condemned. For patients to be awakened at night by the rolling of the tub to the bedside, and then to lie awake for a long time in dread of the coming tub, which always seems much more formidable at night than by day, is often sufficient to cause mental disturbances more harmful than are overcome by the good effects of the bath.

The tub itself should be as simple as possible. It should be placed upon a truck with rubber-tired wheels, as shown in Fig. 1.

The rim of the tub should be on a level with the bed, so that it is not necessary to lift the patient over it, as with heavy patients there is danger of dragging, and so injuring the back upon the edge. Nor

should the patient be allowed to sink far down into the tub, as the discomfort to the nurse is materially increased thereby. The importance of having high beds is strikingly seen here.

It is of the utmost importance that the patient be perfectly comfortable in the tub and not in a condition of muscular strain. The best method to secure this is by means of a device introduced by Miss M. James, a graduate of the Johns Hopkins Hospital Training School for Nurses. This is shown in Fig. 1, and consists merely of three pieces of heavy canvas, 44 inches long, which are held in place and securely fastened by small metal clamps. These are readily adjustable, so that after the patient has been placed on the canvas it may be raised or lowered so as to bring his body just underneath the surface of the water; but most important, any portion may be raised or lowered, and so the sensation of strain when all portions of the back are not equally well supported may be prevented. It is of special importance that the head, especially the ears, be not allowed to sink below the surface of the water; this can well be arranged by changing the position of the clamps supporting the upper piece of canvas. The head should rest upon an air-ring, and this should not have too large an opening (the one shown in the cut is too large). The tub should be filled two-thirds full of water. It should be emptied after each bath and fresh water supplied. This is not always done, in many hospitals it being the custom to keep a tub filled with water for each patient, the water being changed only every twenty-four hours. This is to be condemned for both esthetic and hygienic reasons.

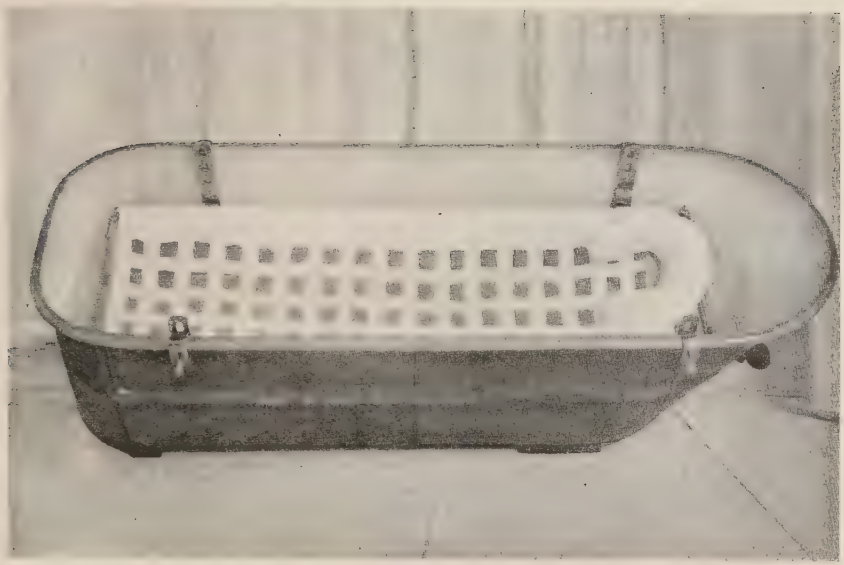
Preparation of the Patient.—The gown should be removed and the patient covered simply by the sheet. Plugs of cotton should be placed in the ears. This is of considerable importance, as permitting the water to accumulate in the ears often leads to the accumulation of wax, temporary deafness, and to the occurrence of furunculosis, as well as being a source of great annoyance to the patient. Women having long hair should wear ordinary rubber bathing-caps. If the skin about the toes is wrinkled or cracked, or if there is any tendency to this, as so often occurs after frequent bathing, they should be well covered with vaselin. In such cases, too, it is important to keep the toes out of the water, which may be done by elevating the lower piece of canvas.

Lifting the Patient into the Tub.—In the ordinary case of mild or of moderate severity this can best be accomplished by the nurse or orderly placing his arm under the patient's shoulders, and by the second nurse or orderly taking the feet, and then by the patient holding himself stiffly, which they do usually unconsciously, the patient is lifted into the tub with practically no exertion on his part (Fig. 2).

The sheet covering the patient is carried over into the tub with him, so that during the bath only the portion of the body being rubbed need be exposed. In cases where the patients are very heavy, or extremely ill and weak, or where they are delirious, it is sometimes advisable to have the assistance of a third person, if this be possible, who leans over the tub and places his hands under the patient's buttocks, and so assists

Fig. 1.– Ingenious device invented by Miss M. James. This arrangement supports the patient's body just beneath the surface of the water (American Journal of Nursing).

Fig. 2.—Lifting patient into tub. Typhoid fever, American method (Cohen).

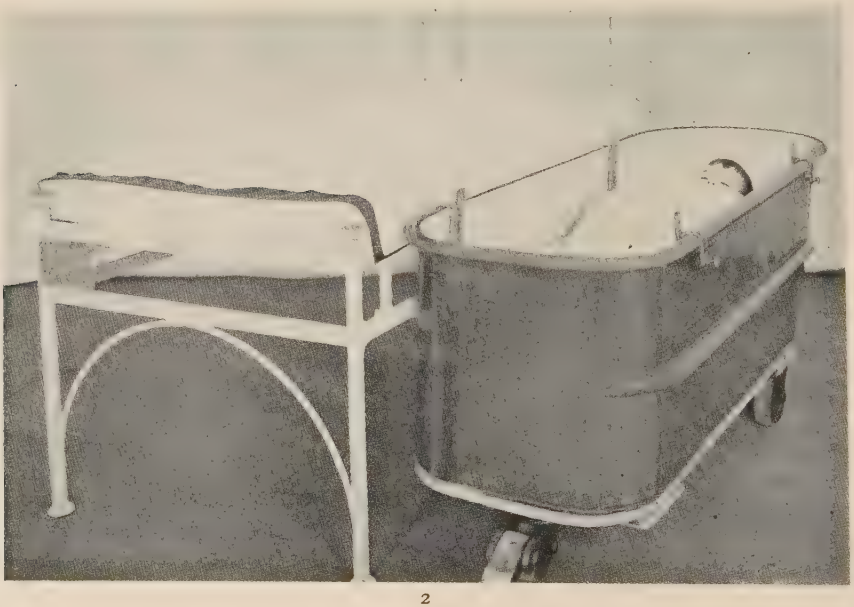


1

2

Fig. 3.—1. Typhoid stretcher devised by Miss Nancy Ellicott; 2, typhoid stretcher on tub (American Journal of Nursing).

1



2

Fig. 4.—Typhoid stretcher devised by Miss Nancy Ellicott: 1. Typhoid stretcher ready for immersion; 2, patient immersed (American Journal of Nursing).

in lifting this portion of the body, and prevents the scraping of the back over the edge of the tub, which may cause bruises and lead to the formation of decubital ulcers.

A very ingenious arrangement for lifting such patients, which is also used as a support in the tub, is one devised by Miss Ellicott. This is well shown in the illustration (Figs. 3 and 4). "This stretcher consists of a hammock made of stout webbing strung between two poles, which are made of hickory or some other stout wood, and finished at the ends with brass tips, so cast as to provide a ring at each end of the pole. These are connected by means of cross-pieces similarly constructed, the ends of which fit into the holes in the extremities of the long poles, thus forming a secure rectangular frame. The hammock is slipped under the patient, much as a fresh sheet would be, the poles are then slipped into the wide hems at each side, the cross-pieces fitted into place, and either a rubber ring or a horseshoe pillow is placed under the patient's head. The stretcher is then lifted into the tub, to rest upon two pairs of hooks which depend from the side of the tub, much as picture-hooks do from a molding." This stretcher has been in practical use, and has been found very satisfactory for the above-mentioned class of patients. With the majority of cases, however, it is not necessary, and the delay in placing the patient on the canvas, adjusting the poles, etc., is likely to make the patient nervous. The more simply the whole procedure can be carried out the better, though it must be with the minimum exertion on the part of the patient. Some physicians even make a habit of allowing patients to step into the tub, or, even in private practice, of allowing them to walk into an adjoining bath-room. We feel that this habit is to be severely condemned, and where it is possible to carry out hydrotherapeutic measures only in this way we think they had better be entirely omitted.

Preparation of the Bed.—As soon as possible after the patient is in the tub and the nurse has commenced the bathing, she should prepare the bed for his return, or, if there is an assistant, the bed should be prepared by her, so that in case an emergency should arise the bed will always be ready for the immediate return of the patient. The bed is prepared by placing over it a large rubber sheet and on top of this an ordinary cotton sheet.

Giving the Bath.—One nurse is sufficient, if she have an assistant to aid her in placing the patient in the tub. She should be provided with a large rubber apron, to prevent the splashing of the infected water over her clothes, and it is advisable that she wear rubber gloves if they can be obtained of a suitable variety. This is rather difficult, as the ordinary rubber gloves are apt to irritate the patient's skin.

On the table at the head of the tub is placed a pan containing ice-water, and there should be two thick cloths, one of which is kept in the ice-water and the other over the patient's forehead; these should be exchanged every three or four minutes. As soon as the patient enters the water the nurse should begin rubbing, and a good deal of the success of the tub depends upon the thoroughness with which this is carried out.

Vigorous rubbing not only adds much to the patient's comfort while in the tub, but is very important for the stimulation to the nervous system which the tubs give. There should be a routine employed, one extremity after another being thoroughly rubbed, and then the chest and back. Water should be thrown up over the chest, as this causes the patient to take the deep breaths which are of so much value in preventing hypostatic congestion of the lungs. The giving of tubs is hard work, and we fear it is too often felt that a tub consists merely in placing the patient in the cold water, whereas the mechanical part is very essential. Certain writers, indeed, have claimed that the massage is the essential part, and that the use of the water may be dispensed with without diminishing the favorable effects. If possible, it is advisable, though not necessary, to have two nurses give the tub, as then the rubbing can be carried out much more effectively. The physician should always be present when the first tub is given, and, if the patient's condition is serious, it is advisable that he be invariably present, if possible, to advise that the tub be discontinued should any alarming symptoms arise. It is advisable to give the first tub in the daytime and not at night, as a great deal of the ease with which subsequent tubs are given depends upon the manner in which the first one is taken. If the patient is delirious, or if there is hyperpyrexia, it is always advisable to have several persons to give the tub, and the rubbing should be carried on with vigor. It is well from time to time to draw the arms away from the body and throw the water high up into the axillæ. It is of importance that the thermometer be kept in the tub, and that the temperature of the water be kept constantly that at which it is desired the tub shall be given. This necessitates the constant addition of cold water, as with a patient with high fever the water is very quickly warmed by the heat from the body.

The usual rule is to keep the patient in the tub twenty minutes, though this may be modified under various conditions mentioned later.

Removal of the Patient from the Tub.—The sheet is placed over the sides of the tub, covering the patient, but not touching the water. The wet sheet is drawn to the foot from below. Then the patient is lifted in the same way as before and placed on the bed, being covered by the sheet which was placed over the tub. The sheet is wrapped about him and the under sheet wrapped over this; on account of the wet body, both sheets become moist, and the patient is in what is virtually a wet pack. Usually the patient is left in these sheets for ten minutes and then is rubbed dry with a coarse towel.

Baths in Private Practice.—The difficulty in giving baths in private houses is one of the chief reasons for advising all patients with typhoid fever to be treated in hospitals. In houses that are quite large, and where there is a bath adjoining the room in which the patient is ill, it is quite possible to have a portable tub and carry out the treatment just as satisfactorily as can be done in hospitals. This is the exception, however. It is not advisable to carry patients into the bath-room and put them into a stationary bath-tub, as this requires too much exertion on the part of the patient. Where it is impossible to send patients to the hospi-

Fig. 5.—The "sluice" bath (American Journal of Nursing).

tal, and where portable tubs cannot be employed, it is probably better to make use of one of the numerous forms of bed-baths which have been devised.

Bed-baths.—With a large rubber sheet and rolls of blankets, or hair pillows to be placed along the sides and above, a fairly satisfactory shallow tub can be made, in which a patient can be given a bath, which, while not so satisfactory as a tub-bath, inasmuch as the patient cannot be completely covered by the water, yet is better than the ordinary sponge bath. A better method is to use a rubber sheet stretched over a frame. This form of apparatus can be obtained from medical supply houses; a very good form is known as the Dr. Burr portable bath. The rubber sheet is passed under the patient, then the collapsible rectangular frame is placed over him, so that it rests upon the mattress, and the edges of the rubber sheet are then hooked to the frame by means of rings (Fig. 5). Dr. Haven[1] has given the following directions for the construction of a very simple, cheap, and ingenious substitute for the bath: "Tie a loop of rope firmly around the headboard, another around the footboard, and connect by two parallel ropes; attach the edges of a piece of oil-cloth, passed under the patient, to the rope with clothespins, and you have as comfortable a bath as the most expensive at a cost not exceeding seventy-five cents. The loops around the headboard and footboard may be dispensed with in metal beds. Four feet of garden hose with a wooden plug in one end makes an excellent siphon." In all of these methods several pails of water may be poured over the patient, and then when the bath is finished, the water can be allowed to drain away by means of a siphon or a fold at the bottom of the tub. In some places not even so much water as this is used, but the water is added by means of large sponges, the water being allowed to drop from a distance upon the patient's chest. Then the water is again absorbed by means of the large sponge, placed in the pail or basin, and cold water is again allowed to drop on the patient, his extremities in the meantime being rubbed with a wet sponge. This method of hydrotherapy is employed practically exclusively at the Massachusetts General Hospital, with excellent results. The affusion of cold water upon the chest acts very well as a respiratory stimulant. This bathing is usually continued for twenty minutes, just as are the tubs. To be effective the water should be much colder than that used in the tub.

Sprinkling.—Instead of using the large sponges, it is customary in some hospitals simply to sprinkle the patient, placed on such an improvised bath, by means of an ordinary watering can; or one of the tanks used for surgical irrigations may have attached to it a tube, having on the end an ordinary bath-shower, and by means of this the patient is sprinkled with the cold water. In this method, as in sponging, a great deal of the good effect is obtained by the evaporation of the water, which, as is well known, withdraws heat. To render this more efficacious it has been advised to cover the patient with thin gauze, and, after sprinkling him with the ice-water or, better, water mixed with alcohol, to fan

[1] Med. Record, 1898, liii, 71.

with large palm-leaf fans, or to have an electric fan at the foot of the bed. This method is said to give very good results in the hands of those who have employed it.

Sponge-baths differ little from the bed-baths previously described, except that smaller amounts of water are used. In giving "sponges," the patient should be placed upon a rubber sheet, cold compresses should be placed upon the head and abdomen, and changed every four minutes. Each extremity should be sponged separately, the nurse making long strokes with the wet sponge, preferably over the large vessels along the inner sides of the arms and fronts of the thighs. Unless the temperature of the water is very cold, such sponges do very little good in lowering the temperature, but, by using large sponges and considerable amounts of ice-water, they can be made very efficacious. The sponge should last for twenty minutes, and then the patient should be wrapped in the wet sheets in which it is given and allowed to remain in the wet pack for ten minutes longer.

Advantages of the Various Methods of Hydrotherapy.—I feel that the most efficacious form in which external hydrotherapy can be used is the cold bath, as has been described. Next to this I would place the bed-baths with affusions of cold water.

The following are the main advantageous effects to be expected from the use of this method:

(1) Effect on the nervous system. This is probably the most important of all the effects obtained by hydrotherapy. The nervous manifestations in typhoid fever are undoubtedly a fairly good indication of the degree of toxemia, and the results of hydrotherapy are seen most markedly in the alleviation of these manifestations. In cases of moderate severity the effects are not so marked, but probably in many of these cases the absence of nervous manifestations is due directly to the early administration of hydrotherapy. With the baths the delirium lessens, the tremor diminishes, and the mental condition becomes much clearer. The effects are best seen in cases with severe, active delirium, subsultus tendinum, and carphologia. I have often seen patients enter the hospital showing these manifestations to a marked degree, and in twenty-four hours, under the influence of active hydrotherapy, the mental condition has cleared and the patient's nervous condition has become markedly improved. In these severe cases the hydrotherapy must be very actively pushed. In these cases the temperature is no indication of the necessity for baths. They must be given frequently whether the temperature is high or not, and, if the patient reacts well, the temperature of the baths should be reduced as low as can comfortably be taken—low enough at least to relieve the symptoms—and this may almost always be done if the method is carried out conscientiously and thoroughly. The good results are not always made manifest by the lowering of the temperature, but in many cases the patient becomes quiet and may even go to sleep while the temperature remains elevated. In wards where hydrotherapy is carried out as a routine measure, patients exhibiting the so-called typhoid state are rarely seen.

(2) The excretion of toxin is increased. This, of necessity, is largely hypothetic, and is inferred mainly from the fact that the so-called toxic features become so much ameliorated. Elimination through the kidneys, however, is increased, and it is probable that there is an associated elimination of toxins. The action on the kidneys is probably mainly secondary to the action on the heart and circulatory system.

(3) The temperature is reduced. This is not the main value of the bath, in fact, it is the least important result of this form of treatment; nor are the good results parallel to the lowering of temperature. Formerly it was thought necessary to give the baths cold enough to reduce the temperature, in order to be of value; in fact, Brand thought that in this way it would be possible to produce complete apyrexia. Now we know that in many cases the effect on the temperature is minimum, while the general effects are excellent. The recognition of this fact has led to the abandonment of the bath at the very low temperatures formerly employed. At the height of the attack the temperature is little if at all affected. Later, a drop of three or four degrees, or even more, occurs with each bath, and this is an indication that the toxemia is less and that the disease is approaching its end. Much harm instead of good was undoubtedly done by the very cold baths which were formerly given.

(4) The condition of the circulatory apparatus is improved. The heart rate usually falls, the pulse becomes smaller and harder, the dicrotism usually disappears, and the blood-pressure rises 15 to 20 mm. of mercury.

(5) The condition of the respiratory system is beneficially influenced. Bronchitis occurs less frequently, and, when present, is benefited by the hydrotherapeutic measures. There is less likelihood of the occurrence of passive congestion at the bases of the lungs. Every time the patient is placed in the tub he takes several deep breaths, and usually, during the entire time he is in the tub, the respirations are slower and deeper. The deep breathing is stimulated by the rubbing of the chest and the splashing of water over it. This is one of the advantages claimed for affusion as compared with tub-bathing.

(6) The liability to bed-sores is diminished, as the skin is kept clean and constantly stimulated. It is questionable, however, whether the frequent moistening of the skin has any tendency to increase the frequency of furunculosis. Some have claimed that it does increase the frequency of this complication. I know of no statistics, however, which support this view. If there is a tendency to boils, the tub should be used only for the one patient, to avoid the infection of others.

(7) The mortality is reduced. This, after all, is the main reason for giving the baths, and if, as appears probable, six to eight patients out of every hundred are saved thereby, there is more than sufficient justification for all the increased labor and trouble to which they give rise. Even if there is only *one* in a hundred saved, the method is well worth the trouble and the additional discomfort to the other ninety-nine. It is somewhat difficult to determine accurately by the statistical method the results of this method of treatment. The most satisfactory figures

are probably those furnished by F. E. Hare from the Brisbane Hospital.[1] Of 1828 cases treated on the expectant plan, the mortality was 14.8 per cent.; of 1902 cases treated since the introduction of hydrotherapy, the mortality was only 7.05 per cent. In the Johns Hopkins Hospital, since its opening, among 1500 cases the mortality has been 9.1 per cent. During the first year, 8 out of 33 patients died, 24.2 per cent., which was probably largely due to the fact that so many patients were admitted in practically a moribund condition. Since the first year hydrotherapy has been actively and consistently used; the mortality of 9.1 per cent. speaks well for the value of this method. It must always be borne in mind, however, that the severity of typhoid fever differs very markedly in different epidemics and in different cities. During the first ten years in this hospital, of 829 cases the mortality was only 7.5 per cent. Since then there has been no change in the routine treatment, except the treatment of intestinal perforation. The introduction of surgical methods in the treatment of this complication has been a decided improvement, and by it patients are saved which would formerly certainly have died. Notwithstanding this, however, it is evident that the mortality in the past few years has been higher. This must be due entirely to differences in the severity of the disease. At present hydrotherapy is so generally employed in some form in all good hospitals that it is difficult to find any records for comparison. Certainly the mortality from typhoid fever to-day, in this country at least, is lower than it formerly was, and probably lower than it is in England, if the statistics of the London Fever Hospital of 18.5 per cent. mortality are to be considered as representative. In both Germany and America the mortality rate is less than it was twenty to thirty years ago, and there is a marked uniformity in the death rates from the best hospitals in these countries. Griessinger (1864) and Murchison (1862) placed the death rate at about 18.5 per cent. Curshmann (1898) gives the death rate in 3600 cases treated by him as 9.3 per cent. He has not employed hydrotherapy so consistently and accurately as is done in the Johns Hopkins Hospital. Of 4100 cases collected by Kinnicutt, from Boston, New York, and Chicago hospitals, the mortality was 11.2 per cent., while among 717 cases at the Montreal General Hospital, the mortality was 9.2 per cent. These figures are in striking contrast to the figures of Griesinger and Murchison given above, and to those of Jaccourd, who gave a mortality of 19.23 per cent. for 27,000 cases in France. Whether the reduction in mortality in late years can be ascribed entirely to the introduction of hydrotherapy, is questionable. Certainly, with improved methods of diagnosis, more of the mildest cases are recognized and included in the statistics; also the improved methods of nursing must be given a share in this reduction of mortality.

The reduction in mortality due to hydrotherapy is due to the saving of cases which would otherwise die as the result of the toxemia. Our experience, as well as that of Hare and others, would indicate that bathing has no effect on the incidence or mortality from hemorrhage

[1] Practitioner, 1897, lviii, 254.

or from perforation, nor does it alter the frequency of relapse, as has been claimed. Whether the average duration of the disease is affected by the bathing or not is difficult to say.

Objections.—The chief objection raised to this method of treatment is that the baths are troublesome to give and that they cause discomfort to the patients. The former we may pass by, as the reduction of mortality, which seems well established, is sufficient justification for the added trouble. As to the discomfort to the patient, this is not nearly so great as is anticipated by those who adopt the method. With the warmer baths now being employed there is very little difficulty, and it is rare to have a patient raise serious objections to the employment of the baths. Formerly, when the method was first introduced, and the baths were given at 60° to 65° F., or even lower, and when pieces of ice were placed in the water, it certainly gave rise to a great deal of discomfort.

With the present method, after the first shock is over, they are not at all disagreeable, and the greater comfort following the tub, with the clearing up of the sensorium, is by most patients felt to more than repay them for the slight discomfort undergone. Some patients prefer the tubs to the sponges, others like the sponges better. The sponges usually are not so alarming to nervous patients, and, therefore, it is well to begin hydrotherapy with one or two sponges before proceeding to the use of the tubs. If the patient is very nervous, the first sponge may be given with tepid water, to which is added some alcohol, and the succeeding sponges may be gradually made cooler. Much depends upon the way the tubs are given as to whether they are disagreeable or not. If firm and continuous rubbing be employed, and there be no delay in getting patients in and out of the tub, they are not at all to be dreaded, and do not justify the severe criticism which has been made of cold bathing as a therapeutic measure. It has been well advised that every one employing such methods in his practice should first submit to a cold tub, given in the ordinary way, so that he may be acquainted with the discomforts which may arise.

Indications for Bathing, Etc.—Brand insisted that all cases of typhoid fever should be bathed from the start, and this, I believe, to be the proper method. The practice of bathing only the very ill patients, or delaying the inauguration of systematic bathing until the patient's condition becomes serious, I believe is to be condemned. Of course, in every series of cases there are a few in which the symptoms are extremely mild, and the temperature hardly at all elevated, and in which, before the diagnosis is definitely established, the temperature may become normal and all the symptoms disappear. Manifestly there will be no advantage in bathing such patients. Cases in which the diagnosis is doubtful, offer serious difficulties in regard to the question as to the advisability of instituting hydrotherapy. It is always best to give the patient the benefit of the doubt. I have never seen any harmful results arise from the bathing of doubtful cases which later proved to be pneumonia, pleurisy, malaria, etc. A more serious difficulty, however,

arises in connection with the cases which are suspected to be, or which finally turn out to be, pulmonary tuberculosis. It is very questionable whether bathing may not do such cases harm, but I have never seen any very definite, unfortunate results occurring in this way. In any case, the mistake would only be likely to occur with extreme rarity.

It is unfortunate that the physician cannot see the patient almost constantly during the course of his disease, and so judge in each instance as to when a bath is required. Manifestly, this is impossible, and it is quite necessary that in the ordinary cases, at least, there be some rule to guide the nurses in the administration of the baths. As I have before stated, the elevation of temperature is not so good a criterion by which to judge of the necessity for bathing as are certain of the other symptoms, especially the nervous symptoms, but in one case we have a definite standard by which to judge, and in the other the decision would have to be a matter of personal judgment. It is, therefore, customary to use the temperature as an indication for the necessity for a bath, and the rule in the Johns Hopkins Hospital is to give a bath every three hours if the temperature be 102.5° F. or over. Counting the added time necessary for getting the patient in and out of the tub, etc., it is impossible for him to have more than seven tubs in the twenty-four hours. In some hospitals the tubs are given less frequently and at a lower temperature; for instance, at the Montreal General Hospital, the tub is given every four hours if the temperature reaches 102° F. It should always be borne in mind that these are general rules, made simply for convenience, and in any case where the nervous symptoms are marked and the toxemia extreme, or where there is hyperpyrexia, the tubs may be given more frequently, or at a lower temperature. The temperature of the baths now employed at the Johns Hopkins Hospital is rarely below 75° F. The majority of cases do not receive baths below 80° F. The customary rule is to give the first bath at 85° F., and, if the case is not a very severe one and the patient reacts well, the temperature of the bath is not reduced. If, however, the patient remains in a toxemic state, and the temperature is not affected materially, the temperature of the bath is rapidly lowered and the frequency is increased. The duration of the baths also in such cases may be lengthened. In fact, in extremely toxic patients, excellent results may be obtained by quite heroic hydrotherapeutic measures, and in such cases one must proceed accurately and rapidly if he hopes to save the life of his patient. The temperature is taken immediately after the patient comes out of the sheets and again three-quarters of an hour later.

In most cases the giving of stimulants at the end of the bath is not only unnecessary, but in most cases it is harmful. If the patient is much cyanosed, and the shivering and shaking following the tub are extreme, a very small amount of whisky sometimes adds very materially to the patient's comfort. Some physicians make it a practice to give a little hot drink, either broth or tea or coffee, to all patients, immediately after the bath. This is not necessary, and the added heat, though slight, may add in some degree to the subsequent elevation of the temperature. Most of the shaking and shivering which occur after the bath are of

nervous origin, and need cause no alarm. They frequently are somewhat distressing to the patient, but usually disappear after the first few baths are given. Some patients show them, however, through the entire course of the disease, no matter how many baths are administered.

Contra-indications to the Use of the Tubs.—(1) *Hemorrhage.*—With symptoms of hemorrhage, or the appearance of blood in the stools, all forms of hydrotherapy should be stopped at once. Before returning to these methods one should wait until all the signs of intestinal disturbance have disappeared, certainly until there are no traces of blood in the stools. It is then well to begin with sponges for a few days before returning to tubs.

(2) *Indications of Intestinal Perforation or of Peritonitis.*—With the onset of severe abdominal pain, or of any suspicious symptoms, the baths should be stopped. As soon as the symptoms all disappear, and one feels certain that neither perforation nor peritonitis is present, the baths may be resumed.

(3) *Phlebitis.*—It is manifestly important that with the onset of phlebitis all unnecessary movements should be avoided. The tubs should be stopped at once, and, if sponges are being given, it is better to discontinue them for a few days at least. When they are commenced again they should be given without the patient being moved, and the nurse should have directions not to bathe the affected extremity.

(4) *Cholecystitis.*—With the onset of severe abdominal pain in the right hypochondrium, the patient should not be moved any more than is necessary, and the baths should be stopped. If the pain is not extreme, there is no reason why sponges should not be given.

(5) *Great Prostration.*—It is very rare that this forms a contra-indication to the use of baths. In cases, however, of marked collapse, or in very old persons showing very slight or no elevation of temperature, the tubs had better not be employed. Mental stupor and dulness, however, must not be confounded with what is meant by great prostration, as it is in these very cases, with marked mental disturbances, that the greatest value from the use of the baths is obtained.

(6) *Cases Seen Late in the Disease.*—Patients admitted to the hospital, or seen for the first time in the third or fourth week of the fever, had probably better not be tubbed, though it is difficult to make any definite rule about this, as baths seem to have a marked effect even in cases in which the baths are begun very late in the disease.

Pneumonia, pleurisy, and bronchitis are not contraindications to the use of the tubs, nor are shivering and moderate grades of cyanosis indications for the removal of the patient from the tub. Such cases often do the very best, and it would be a mistake to remove patients from the tub simply because the lips get a little blue or because the patient has a moderate grade of shivering.

Empiric Methods.—I have already referred to a number of the so-called methods of treatment of typhoid fever which have been claimed by their advocates to be specific. Each one of the antipyretic drugs in turn has been hailed as a sure cure, and iodin, potassium iodid, the

mineral acids, ergot, salicylin and the salicylates, chloral, chlorin-water, and numerous so-called intestinal antiseptics each in turn have had their day and been succeeded by another.

In the first half of the last century the phlogistic theory of fever led to the use of active purgatives and emetics, and also to the employment of venesection, which was frequently carried to an extreme grade; for a time tartar emetic was much employed; and even up to the present calomel is urged by some as a specific in typhoid fever.

It is not worth while to discuss further these methods of treatment. I will simply state that to-day we know of no drug which has a specific action in this disease. The drug treatment of this disease at present must be limited to the application of certain remedies for the relief of definite symptoms. The mild case, or the one of moderate severity, may go through the entire course of the disease without a dose of medicine; in fact, probably a majority of the cases treated in the Johns Hopkins Hospital receive no medicine at all from the beginning of the disease to the end. If, owing to the almost universal desire for medical treatment on the part of the laity, it becomes necessary to yield to their demands, it is well to prescribe small doses of the mineral acids or other harmless drugs.

Treatment Based on Certain Predominant Symptoms.—While I have expressed great skepticism as to the value of any of the so-called specific methods of cure in typhoid fever, I, nevertheless, feel that the opportunities offered to the physician for greatly benefiting the patient by careful observation of the symptoms and the proper application of drugs for the relief of these symptoms may be very great, and that he may thereby not infrequently succeed in saving lives which would otherwise be lost. He may also render his patient much more comfortable and prevent distressing and even serious complications.

(1) *Gastro-intestinal Symptoms.*—The quieter the bowels are kept the better. Constipation is to be desired rather than diarrhea. The giving of laxatives or purgatives during the course of typhoid fever is not only unnecessary but harmful. Nathan R. Smith said, "I have never known a patient die of typhus whose bowels were slow and required laxatives to move them."

As to the value of an initial dose of calomel at the onset of the disease it is difficult to judge. A large number of clinicians advise this, and, if the case is seen early, it probably does no harm and cleans the bowel of accumulated fecal material. If the case is not seen until after the first week, however, this had better be omitted. If the bowels are constipated and fail to move, it is well to clean the lower bowel out every second day with a small soapsuds enema. This, in the Johns Hopkins Hospital, is a routine practice, and active purgation is never required. During the latter stages and in early convalescence the condition of the stools should be carefully watched, and if there is any tendency to marked constipation the enema had better be given daily. Occasionally, though very rarely, unless this precaution be taken, fecal impaction may occur, but I have never seen this complication to be of any serious importance. It can

usually be relieved by the high injection of 6 ounces of sweet oil, followed in two hours by an enema consisting of 1 liter of warm water containing 6 ounces of Epsom salts.

Diarrhea is much more difficult to control, and when the patient is on a proper diet its occurrence usually indicates a very severe infection or marked involvement of the colon. There can be no doubt that diarrhea is at present much less frequently a symptom in typhoid fever than was formerly the case; almost all hospital statistics indicate this, and I feel that this is due, first, to the discontinuance of the practice of giving purgatives, and, second, to the almost universal use at present of milk as the main article of diet, and the restriction of the use of meat extracts and bouillon and other highly flavored fluids which were formerly employed. In the treatment of diarrhea the first attention must be given to the regulation of the diet. The stools should be examined, and, if they contain curds, the milk must be more diluted with lime-water or even entirely stopped and replaced by whey.

If the diarrhea still continues and is marked, it is well to cut off food entirely for a day or so, giving nothing but water by mouth. As soon as the diarrhea has stopped one may commence cautiously by giving small amounts of unflavored egg-albumen, then adding gradually to the dietary whey and, later, milk. In most cases this course of treatment will prove efficacious. Certain other measures, however, may be of aid. To restrict the peristalsis of the bowel the application of a large, flat ice-bag, such as the so-called pneumonia bag, fairly heavily weighted with ice, is often of value. In emaciated patients care must be taken that the pressure is not too great upon the prominent bony elevations, such as the crest and spines of the ilium and the costal margins, as if this occurs there is danger of decubital ulcers arising. Drugs by the mouth are rarely needed, though bismuth given in doses of 40 gr. every four hours may be of aid, and in severe cases opium may be necessary. This may be given as tincture of opium, ♏v; or large doses of bismuth may be combined with Dover's powder. Certain astringent preparations, such as tannigen or tannalbin, gr. v every four hours, may be employed, or the following acid diarrhea mixture may be used:

℞ Plumbi acetatis..... gr. ij;
Acidi acetici diluti..... ♏xv or xx;
Morphinæ acetatis..... gr. $\frac{1}{6}$ to $\frac{1}{8}$.—M.

The lead-and-opium pill is also of value:

℞ Plumbi acetatis..... gr. ij;
Pulveris opii..... gr. ss;
Camphoræ..... gr. ij.—M.

or the pilula plumbi cum opio of the British Pharmacopœia may be employed. In severe cases, and where there seems to be much irritation of the rectum, enemas consisting of starch-water, 6 ounces, containing laudanum may prove of signal service. There is no reason for discontinuing the baths in these cases; in fact, there is good evidence that the baths may be helpful.

Meteorism in a very mild form is not necessarily a serious complication, but is always to be viewed with some alarm, and in its more severe forms is an indication of extreme toxemia and of paralysis of the bowel. The time to treat meteorism is when it is in the very mildest grade, or *beforeit begins*, as after it becomes marked we are often entirely helpless and unable to relieve it. It can best be prevented by strict attention to the details of diet and by lessening the toxemia by the means which I have previously indicated. If, in spite of the careful attention to the diet, the distention becomes more marked, it is well to stop the food entirely, just as I have indicated in cases of diarrhea, with which symptom, meteorism is very often associated. With the disappearance of the diarrhea the distention usually also subsides. Moderate degrees of distention can often be relieved by the use of turpentine stupes, made by wringing thick pieces of flannel out of very hot water containing a dram of turpentine to the quart. These should be frequently changed, so that the skin is made quite red. Turpentine is the chief drug we have to rely upon for the relief of tympanites, and should not only be used externally, but by the mouth and rectum as well. By the mouth it should be given in doses of from 5 to 10 ♏, and per rectum it should be given in doses of from ½ to 1 dram in large enemas of warm water. If these measures do not prove effectual, or in any case, it is well to pass the rectal tube as high up in the bowel as possible and to leave it there until expelled. The physician himself should attend to the introduction of the rectal tube, otherwise harm might be done if ulceration of the sigmoid were present, and also, unless great care be exercised, a rectal tube usually doubles upon itself, and does not pass above 2 or 3 inches from the external sphincter.

Oil of cinnamon in doses of 3 to 5 minims every two hours may be tried; charcoal, bismuth, and beta-naphtol have been recommended on account of their supposed antifermentative action, but, as they tend to diminish intestinal peristalsis, it is doubtful whether they do more good than harm. Eserin or physostigmin sulphate given hypodermically, gr. $\frac{1}{50}$, on account of its direct stimulating action on the walls of the intestines, has been employed. It is not warmly recommended, however, by those who have used it, but in serious cases may be tried. In case there is much gastric distention, as well as distention of the bowel, if it cannot be relieved by the simple carminatives, the passing of a stomach-tube sometimes affords great relief, and may prevent embarrassment of the action of the heart, which is often one of the most serious results of marked tympanites.

Abdominal pain, when it occurs acutely, is always an indication for the greatest care on the part of the physician, and, instead of being a symptom calling only for relief, is often a feature of the greatest value in drawing attention to more serious lesions within the abdominal cavity. When it is of mild grade, however, and is persistent, present from day to day, and not depending upon peritoneal irritation, it may sometimes be relieved by the application of hot turpentine stupes, or by changing the diet, stopping the milk for a time, and substituting whey. *Opium should not be given for abdominal pain*, for a pain which is severe

enough to require opium is usually caused by some serious complication, and the giving of this drug may disguise the features and cause it to be overlooked.

Nausea and vomiting are most frequently of nervous origin, occur most often in women and children, and in the treatment the greatest stress should be laid upon the diet. Of course, when occurring in association with abdominal pain and rise of fever, they usually indicate some serious lesion, but when chronic they may often be relieved by the use of some of the more simple drugs employed as gastric sedatives, such as small doses of carbolic acid, 1-drop doses of ipecac, Hoffmann's anodyne, small amounts of champagne, etc. In marked cases it is best not to delay too long, but to have recourse to the stomach-tube, the use of which on one or two occasions usually causes the symptoms to disappear.

(2) *Nervous Symptoms.*—Headache may usually be relieved by the use of the ice-cap, and this should be frequently renewed and be large in size. One may be placed over the vertex and one at the back of the neck, and the one at the vertex should not be allowed to rest its full weight upon the head, but may be supported by a bandage tied to the head of the bed. There is always some headache in the earlier weeks of typhoid fever, and, if it is not too severe, the physician should not bother too much about it, and should not employ large amounts of so-called headache remedies, thereby upsetting the patient's digestion and his stomach. An occasional small dose of phenacetin may be of value.

The general nervous symptoms are best relieved by hydrotherapeutic measures, and, as I have previously said, when these symptoms are marked, the hydrotherapy should be actively pushed, and the physician himself should take these measures in hand and see that they are carried out in the proper degree and manner. Insomnia is also best overcome by the hydrotherapeutic measures, and when it is present after the temperature has fallen, so that the indications for baths are not present, it is well to give a cold pack at night, wrapping the patient in wet sheets and allowing him to remain in them for twenty minutes or longer. If the patient is restless and wakeful during the course of the disease, and does not sleep in the intervals between the nourishment and baths, the nurse should be instructed not to awaken the patient when he once gets asleep, but to use judgment in giving nourishment and baths, giving them during the times when the patient is awake. Care should be taken, however, that in such cases the patient is not really in a stupor as the result of profound toxemia, as in such cases the baths are the very things he needs, and should not be omitted. It is only in rare cases that during the height of the disease it is necessary to omit giving the nourishment and baths and taking the temperature during the night; the doctor should have these details of the case constantly before his mind, and should leave accurate instructions with the nurse as to what course is to be pursued in each individual case. If the wakefulness is extreme, and it is apparently not a result of the toxemia, trional may be given, but it is best to be given in the form of a suppository (gr. xx). Other sedatives, such as sulphonal, amylene hydrate, bromid, and chloral may be tried in

individual cases, but it is best to avoid as far as possible the giving of drugs by the mouth. Sometimes giving the milk slightly warm instead of cold may cause the patient to go to sleep.

(3) *Renal Symptoms.*—Retention of urine not infrequently occurs when the patient is first put to bed or when he is first admitted to a hospital. This is usually a nervous symptom and must not be taken too seriously. It is very important that the patient be not catheterized at once, as otherwise it may have to be continued during the greater part of the disease, with resulting cystitis, which is almost bound to occur in spite of the greatest precautions. If, after the patient is put to bed, he is unable to void, hot wet stupes should be placed over the lower abdomen and a hot enema should be given. If he is still unable to void while lying down, he should be allowed to sit on the side of the bed or even stand upon his feet. After doing this once or twice he is usually able to void while lying down. Catheterization may in the end be necessary, but it is advisable not to employ this until all other means have failed. Incontinence is a rare symptom, and usually occurs only in the more severe grades of toxemia and when the patient is comatose or delirious. Care must be taken that the incontinence is not a paradoxic one, and in all cases the bladder should be examined daily as a part of the routine abdominal examination, to make sure that it is not distended. In such cases, if the patient is not able completely to empty his bladder, catheterization should be employed.

Bacilluria.—In about 30 per cent. of the cases of typhoid fever typhoid bacilli may be cultivated from the urine at some stage of the disease. In the vast majority of cases the presence of these bacilli in the urine does no harm to the patient himself. In a few cases a true typhoid cystitis associated with symptoms occurs. It has been shown that the occurrence of typhoid bacilli in the urine can be prevented, or, if they are present, they may be made to disappear, by the administration of urotropin. Fuchs[1] has shown that by giving 2 gm. of urotropin during each twenty-four hours of the entire course of the disease, typhoid bacilli can almost positively be prevented from appearing in the urine. Thus, in 53 cases not prophylactically treated, typhoid bacilli were found in the urine fifteen times, while in 40 cases treated prophylactically, in only 1 case did typhoid bacilli appear. He, therefore, advises giving urotropin during the entire course of the disease. Others have advised it only in the later stages, basing their view on the fact that typhoid bacilli in the urine are much more likely to occur in the later stages and during convalescence. There are certain objections to giving this drug during the entire course of the disease. First, in a few cases the continued administration of this drug has led to the occurrence of hematuria, without, however, producing any lasting results, so far as I have been able to determine. So, too, giving drugs of any sort or description is likely to upset the digestion during the course of this disease, a thing which we desire to avoid at all costs. After all, the object in giving the urotropin must be mainly to prevent danger to others and not for the sake of the patient, and this danger can be best

[1] Deutsch. Arch. f. klin. Med., 1903, lxxvi, 24.

overcome by careful sterilization of the urine immediately after voiding. Where bacteriologic methods may be employed, cultures should be made from the urine during the course of the disease, and if bacilli are present urotropin should be at once administered. Before the patient leaves the hospital cultures should be made, and if bacilli are present urotropin should be given, and, if possible, the patient should remain in the hospital until the bacilli entirely disappear. Even then, however, the urotropin should not be discontinued, as it has been shown that while urotropin prevents the growth of typhoid bacilli in the urine, it does not prevent their reappearance after the urotropin has been discontinued. Such patients should, therefore, be advised to continue the urotropin at least one month after leaving the hospital.

(4) *Respiratory Symptoms.*—No treatment is usually required for the bronchitis which is of so common occurrence in the early stages of the disease. Usually this disappears very quickly with the bath treatment. The baths are also advantageous in preventing the occurrence of hypostatic pneumonia. By paying strict attention to the mouth and teeth, the occurrence of laryngeal complications can be in great measure prevented.

(5) *Cardiovascular Symptoms.*—Typhoid fever is a disease in which there is low blood-pressure. This is due to some extent undoubtedly to peripheral arterial dilatation, but also probably to the weakened action of the heart due to the effects of the toxin upon this organ. On the other hand, the pulse is usually slow in typhoid fever, but in certain cases, especially in women, nervous patients, and children, the pulse may be quite rapid during the entire course of the disease. These facts must be borne in mind in order that one does not administer cardiac stimulants unnecessarily and under conditions where they may do harm instead of good. In cases where the blood-presure falls below that at which it has been running (no absolute standard can be given), and in which the pulse becomes progressively more rapid and slightly irregular, we must begin the administration of stimulants, and the best stimulant to use at first is probably strychnin. This may be given in doses of $\frac{1}{60}$ to $\frac{1}{20}$ gr. every four hours, either hypodermically or by the mouth, but in most cases I feel that it is better to give the strychnin hypodermically. Most cases may go through the entire course of the disease without ever having had any cardiac stimulants, and I feel that the physician should delay as long as possible before giving these drugs. An ice-bag should be placed over the heart. The baths themselves are excellent cardiac stimulants, and there is no reason why they should be discontinued in case the pulse becomes rapid or slightly irregular. In certain cases, especially in those that have been addicted to alcohol, or in the very strong and robust, where a cardiac stimulant is needed, it is well to give alcohol. This may be given either as whisky, brandy, or port wine, but its use should be limited to those cases in which there are indications of failing cardiac strength. In many places it is the custom to give alcohol after the bath. I think this is a bad practice, and, while in cases where alcohol is definitely indicated it may be administered following the

bath, it should be always kept in mind that the alcohol is not given because the patient has just had a bath, but because the cardiac conditions demand it. If the use of strychnin and alcohol has not been efficacious, and the patient's condition is growing worse, it is well to use digitalin, given hypodermically in doses of $\frac{1}{40}$ to $\frac{1}{30}$ gr. Some writers prefer camphor, given hypodermically in doses of 2 gr. in sterile olive oil every four hours, but in our experience its value has been doubtful. The same may be said for ergot, which from its physiologic action would be apparently a drug of choice, is nevertheless of doubtful value. Where cardiac stimulants are needed, therefore, we would advise first strychnin and alcohol, and when these are not efficacious, the use of digitalin. Hypodermoclysis may be employed in extreme cases, but is of value probably more on account of its effect in promoting the excretion of toxins than on account of any direct effect on the circulatory system. It does cause a raising of blood-pressure, but this is very transient.

The Treatment of Complications

Typhoid fever is a disease of many complications and sequels. The patient is only partially through his troubles when his disease has been conquered. There are two groups of complications. These may be spoken of as toxic and suppurative. Probably in most cases the complications are due to the localization of bacteria in the tissues, but in one group it is difficult to demonstrate the bacilli and the lesions do not suppurate, while in the second group the cultivation is more easy, and the lesions are suppurative in character. For a long time it was thought that the typhoid bacillus did not produce true suppuration, but, while it is still difficult to prove that it does so experimentally, nevertheless the number of cases in which typhoid bacilli alone have been cultivated from suppurative lesions is convincing that this organism must be classed among the pyogenic bacteria. Why it is that at times this organism takes on these pyogenic properties, and at others, probably under the usual conditions, causes no tendency to suppuration, is not known. The pyogenic complications are usually milder than those produced by cocci, they usually have a longer course, and are more likely to undergo resolution without rupture. Therefore, surgical interference in these cases is not so urgent as in the coccal infections, but with many of them surgical interference is clearly indicated. The treatment of these will be considered under the discussion of surgical treatment.

Skin Lesions (Furuncles, Abscesses, Phlegmons).—These lesions are not uncommon in typhoid fever, and if not properly treated may be very serious, as secondary general infection sometimes occurs, which in some cases may prove fatal. The majority of these lesions are due to pyogenic cocci and differ in no way from those arising under other conditions. A few such cases have been reported as due to the typhoid bacillus alone. These cases, however, cannot be distinguished by any clinical features, and the two groups of cases must be treated alike; the treatment must be surgical, and as soon as discovered, while the lesions are still small,

they should be freely opened and packed. It is well to cover them with a dressing of collodion, as in this way the baths may be continued and the infection is not so likely to be spread.

Bed-sores.—The time to treat bed-sores is before they form. The presence of a bed-sore on a typhoid fever patient should cause not only the nurse but the doctor as well to feel guilty. One of the most important parts of the nurse's duty in this disease is careful attention to the skin, but the physician, too, should have constantly on his mind the possibility of this complication, and should not only urge the nurse to be vigilant, but should make frequent observations himself to see that no ulcers are forming. To prevent bed-sores the most important thing is perfect cleanliness of the skin. The back and buttocks should be rubbed once or twice a day with alcohol. Any points which show redness or signs of pressure should be supported upon air-rings, and if these areas become numerous, and it is difficult to keep pressure off them, the patient should be put on an air-bed or water-bed. An air-bed is to be preferred. The bed should be covered by a sheet and great care should be taken to prevent wrinkles. If there occurs a breaking of the skin, all pressure upon this point should be immediately relieved, it should be kept perfectly clean, and should be irrigated with a solution of boric acid or a solution of hydrogen peroxid. It should then be dried carefully, and an attempt should be made to keep it perfectly dry by placing over it some bland powder, such as bismuth, lycopodium, etc. Care should be taken that the edges of the ulcer are not undermined. If they are, the edges should be raised, the wound should be carefully irrigated and packed, either with iodoform gauze or with gauze moistened with some more stimulating ointment, such as balsam of Peru. The latter is especially valuable in cases where the tendency to granulate seems to be lost. This is a sign of ill omen and usually indicates a severe infection.

Infection of Various Glandular Organs.—Orchitis, mastitis, parotitis, bartholinitis may occur and be due either to typhoid bacilli or to pyogenic cocci. In some cases these lesions go on to true abscess formation and require surgical treatment. In others the inflammation disappears without suppuration. As soon as signs of involvement of any of these organs appear, ice should be applied at once and care should be taken to discover the presence or occurrence of suppuration. If suppuration occurs the treatment must be surgical.

Abscesses in the Deeper Organs.—Abscess of the lung, liver, spleen, kidney, brain, or retroperitoneal glands occasionally occurs in typhoid fever. The treatment does not differ from that employed in such lesions occurring under other circumstances. As soon as the diagnosis is made a surgeon should be consulted and, if thought advisable in the individual case, operative procedure should be undertaken.

Complications Involving Organs of the Circulation.—I have already discussed the treatment of cardiac insufficiency. Acute endocarditis and pericarditis occur but rarely, and the treatment does not differ from that employed for these conditions under other circumstances. An ice-bag should be placed over the heart, and the treatment should be

directed toward the prevention of cardiac weakness. Myocardial degeneration is common in typhoid fever. The treatment is that which we have previously discussed under cardiovascular symptoms.

Arterial and Venous Thrombosis.—Arterial thrombosis should be treated by keeping the involved extremity perfectly quiet, by keeping it wrapped in cotton, and by the application of external heat. If gangrene occurs the surgeon should be consulted, and amputation should be performed above the line of demarcation.

Venous thrombosis should be expected and looked for whenever the patient complains of pain in any part of the leg. Not infrequently in thrombosis of the internal saphenous vein the pain is almost entirely in the calf and lower leg. The nurse must be cautioned always to note the occurrence of pain in the extremities. In case thrombosis is discovered, as indicated by pain, redness, and swelling over the vein, or by the first alone, the leg should be kept perfectly quiet, it should be elevated, wrapped in cotton, and an ice-bag should be placed in the groin or over the thrombosed vessels. It has been advised to employ certain drugs which have the property of preventing coagulation of the blood outside of the body, and in a certain number of the cases I, as well as others, have tried these drugs, especially the use of sodium citrate, or better, citric acid. I have been unable to see, however, any effect in preventing the extension of the thrombosis. If the pain is very severe small doses of morphin may be required.

Post-typhoid anemia may occasionally reach an extreme grade and may be quite a serious complication. When the anemia is mild the patient should be kept out of doors in the sunlight; he should receive as much food as it is thought well to give him, and under this treatment most cases usually get perfectly well. In a few cases, however, the anemia is progressive and somewhat of the type of pernicious anemia. In such cases it is well to give arsenic, either Fowler's solution, or by the hypodermic method, using atoxyl in doses of from 2 to 3 gr.

Renal Complications.—Albuminuria is not an infrequent complication and requires no special treatment, as it does not usually lead to any permanent result. Drinking large amounts of water apparently has no bad effect upon the renal epithelium. In fact, it may prevent some of the cases of nephritis which occasionally complicate typhoid fever.

Cholecystitis.—The medical treatment of this complication consists in keeping the patient quiet, in the application of ice-bags over the hypochondrium, and the administration of large amounts of water. The question in these cases is just how long one is justified in continuing the medical treatment, and when the treatment should be surgical. No definite arbitrary rule can be given, as many of the cases undoubtedly recover without operation. It must always be kept in mind, however, that in a certain number of cases rupture occurs and general peritonitis develops. I have seen one such case which undoubtedly influences me in quite strongly urging surgical interference in almost all cases. Keen, in 44 cases of typhoid infection of the gall-bladder accompanying or following typhoid fever, found that 30 resulted in perforation. Of these

30 cases 4 were operated upon, and of these 3 recovered; while of the remaining 26 not operated upon, all died. I cannot do better than to quote his advice. "I am decidedly of the opinion that in distention of the gall-bladder prompt surgical interference is the best. It is far better to prevent perforation than to remedy it after it has occurred."

Just what the indications for operation must be are difficult to state. The severity of the symptoms, the patient's condition, the facilities for operation must all be taken into consideration. In the very mild cases with pain and with little or no distention, and with very little increase in the height of the temperature, it is probably safe to wait. But whenever the pain becomes very severe, when the gall-bladder distention becomes marked, and the temperature becomes more elevated, operation had better be performed at once. In regard to the distention of the gall-bladder it must be borne in mind that in some cases where stones have previously been present the gall-bladder may be contracted, and rupture may occur in a gall-bladder which could not be palpated. Such a condition occurred in a case seen by me, and fatal general peritonitis developed. In all cases it is better to be on the safe side, keeping in mind the fact that the mild cases usually recover. One hesitates in subjecting a patient just recovering from typhoid fever to the dangers of an abdominal section unless it is absolutely necessary, but when one has decided to wait, he should always realize that he is taking a certain amount of risk and a certain amount of responsibility.

Pulmonary Complications.—Bronchitis, pneumonia, or pleurisy, occurring during the course of typhoid fever, should be treated in exactly the same way as though occurring independently. There is no need for stopping the baths if pneumonia occurs, but if lifting the patient in and out of the tub should cause extreme respiratory distress it is better to give cold sponges instead. If a pleurisy occurs effusion should be carefully watched for; if found, a needle should be inserted, and if the fluid be purulent, operation should be undertaken.

Meningeal Complications.—For the cases of true suppurative meningitis and also the cases of serous meningitis and "meningismus" lumbar puncture seems to be of some value, just as it is in the cases of cerebrospinal and tuberculous meningitis. In cases where true meningitis is present lumbar puncture should be repeated at least every second day. Hydrotherapy is of value in overcoming the mental symptoms, and there is no need for discontinuing the tubs in case meningitis is present.

Psychoses.—For psychoses, delirium, etc., occurring during the height of the disease, there is nothing so efficacious as hydrotherapy, both external and internal. If the patient is violent and it is impossible to give tubs, wrapping the patient in cold wet sheets not only restrains him, but has a very quieting effect as well. In such cases it is always of the greatest importance to watch the patients carefully in order to prevent them injuring themselves or others, and they should not be left alone for a moment. Absolute quiet is of great importance, and friends of the patient should be prevented from coming into the room. If the mental disturbance persists into convalescence cold packs should be con-

tinued, plenty of water should be given by the mouth, and, after the first couple of weeks of normal temperature, the patient should be urged to eat as much as possible. Indeed, in some of these cases feeding must be resorted to rather earlier than is usual in the ordinary cases, and the diet may be more liberal than is customary. It should be remembered that these cases usually recover, and, therefore, the treatment may be continued at home for a longer time than would ordinarily be the case. If, however, the mental disturbance continues for several months after recovery from the fever it is better to consider admitting the patient to a hospital for mental diseases, where the treatment can be more advantageously carried out. It must be kept in mind that even after this period recovery should not be despaired of.

Gastro-intestinal Complications.—The two most serious complications of typhoid fever occur directly in connection with the ulcers in the intestine; namely, perforation and hemorrhage.

Intestinal Perforation.—The most important part of the treatment of this complication is the making of the diagnosis, and after this is once made there is no proper *medical* treatment. After the diagnosis is made operation should be performed at once. Under the old medical treatment practically every case was fatal, but, with the advance in the methods of diagnosis and in surgical procedures, it is now possible to save from 25 to 50 per cent. of all cases having intestinal perforation. The only excuse one can have for not operating in such cases is the absolute refusal on the part of the patient or of his friends to permit operation. The physician must remember, however, that the obtaining of this consent is an important part of his duty, and is essential for the life of his patient. He should, therefore, use tact, and at the risk of his own reputation and the goodwill of the friends urge the necessity of this procedure. A number of such cases will die and the physician may be blamed, but these are the risks he runs, and he must be willing to accept these risks for the sake of those he saves. If permission for operation is absolutely refused, it is best to employ opium to relieve the pain and diminish intestinal peristalsis, to place an ice-bag over the abdomen, and to hope that by some lucky accident the opening may be closed by the omentum or a portion of the mesentery.

Intestinal Hemorrhage.—While this is a very frequent complication of typhoid fever, it is not directly a very serious one. The general tendency is to regard it with much more alarm than its gravity really warrants. Of 1500 cases in the Johns Hopkins Hospital, hemorrhage occurred in 118, or 7.8 per cent, and in 12, or 0.8 per cent., death resulted directly from the hemorrhage. Other statistics give a rather more important place to intestinal hemorrhage as a cause of death, and it is difficult to say whether the treatment employed in the Johns Hopkins Hospital is or is not responsible for the low mortality due to this complication. Most statistics show, however, that bathing has no effect in reducing the frequency of this complication or the mortality due to it. It is probable that the results of intestinal hemorrhage are influenced very little by any active treatment within our power. By knowing what

not to do, however, we may possibly save cases which would otherwise prove fatal.

There are three methods by which, theoretically at least, we are able to stop bleeding from un ulcer. First, we may quiet the intestinal movements, and so favor the clotting of blood over the surface and in the ruptured vessel. Second, we may give medicine by the mouth, with the idea of having it reach the bleeding surface and promote coagulation here. Third, we may give substances, either by the mouth or subcutaneously, with the idea of increasing the coagulability of the blood.

(1) *Diminishing Intestinal Peristalsis.*—The first object is best attained by keeping the patient absolutely quiet. With the first sign of hemorrhage (and hemorrhage may sometimes be suspected even before any blood appears in the stools), the nourishment should be stopped and all water should be discontinued. To prevent the mouth becoming extremely dry, and to prevent the great discomfort from withdrawing all liquids, it is well to allow the patient to place small pieces of ice in his mouth. The patient must be kept absolutely on his back, urged not to move about, and no visitors should be allowed to come into the room. The patient should not be lifted on the bed-pan or urinal, but he should pass the urine and feces into a draw-sheet which may then be removed. In this connection it is well to point out the great danger such patients run of having decubital ulcers form if the back is allowed to become wet and remain so. It is, therefore, important to keep the patient's back as dry as possible by slipping dry sheets underneath him, but without moving him for this purpose. With the first sign of hemorrhage all forms of hydrotherapy should be at once discontinued. Over the abdomen there should be placed an ice-bag. This should be large, and fairly well filled with ice so as to be fairly heavy. This we feel is of great value in diminishing peristalsis, and possibly also to a great extent in causing contraction of the intestinal walls. The same precaution in regard to the ice-bag that we mentioned under the treatment of diarrhea should be observed. During the past few years the value of opium in the treatment of this complication has been much discussed. Formerly it was the rule with the first appearance of hemorrhage to administer large doses of opium, with the hope of keeping the patient quiet and of overcoming intestinal peristalsis. It is questionable, however, whether, in the doses usually employed, opium has very much effect in reducing the peristalsis of the bowel. A second and more important objection to the use of opium is that one-fifth of all the cases of perforation are associated with hemorrhage, and if opium is administered early in these cases of hemorrhage the signs and symptoms of perforation will almost certainly be obscured and the condition may not be recognized until it is too late. We now feel that there is only one condition in which it is justifiable to give opium in any form where intestinal hemorrhage is present, this is when the patient is very restless and it is impossible to quiet him by ordinary means. In these cases opium may be of value, and it is best to give it in the form of morphin in small doses, given hypodermically, so that the effects are

obtained quickly and are transient. The use of ice-cold enemas in this condition has been advised, but the stimulation of peristalsis thereby induced probably more than overcomes the constricting effects of the cold.

(2) *The Use of Hemostatics.*—It is very questionable whether these drugs are of any value in this complication. When one thinks of the large surface of bowel, and how far the medicine has to travel before it reaches the bleeding point, it seems very doubtful whether these drugs should be employed, and clinical experience increases our doubt. There is a further objection in that most of the drugs so employed are rather irritating to the stomach and so are in danger of causing vomiting. Among the drugs which have been employed for this purpose is the tincture of chlorid of iron. This drug is supposed to stop hemorrhage by causing the precipitation of an iron albuminate whenever it comes into contact with blood. As the intestines around the bleeding point are usually filled with blood, the iron in most cases is probably all precipitated before it reaches anywhere near the bleeding vessel. Murchison advised 10 to 20 minims of turpentine every hour in a mixture with mucilage and peppermint water. Acetate of lead and morphin, as in the acid diarrhea mixture (page 243), are sometimes employed; so also the lead and opium pill has been very largely used. This was formerly the routine in the Johns Hopkins Hospital, but is no longer employed, and no bad results have been seen from its discontinuance. Hydrastus has been strongly recommended, but as it causes a raising of blood-pressure its value is doubtful. For the same reason, the use of ergot in this condition is of doubtful value. Both are possibly really harmful. Adrenal extract has of late years been employed to a considerable extent, and favorable reports of its use in small series of cases have appeared, but as it is probably mainly absorbed before it reaches the ulcer, and as it has little effect when administered in this way, it probably does little good. Probably it is well that its effect *is* very slight when administered by the mouth, as otherwise the increase of blood-pressure which it would induce would be harmful rather than of value. However, some have advised its use hypodermically, with the hope that it might produce constriction of the intestinal vessels. Proof, however, that by its subcutaneous administration the intestinal vessels are constricted is still lacking, and one should be very careful in administering this drug for the control of internal hemorrhage of any sort.

(3) *Substances Employed to Increase the Coagulability of the Blood.*—The best drugs which we have for this purpose at present are salts of calcium, and it has been shown by Wright and others that by the administration of this drug the coagulation time may frequently be reduced. Calcium is best given either as calcium lactate or calcium chlorid, 20 to 40 gr. or more every four hours. The former is less disagreeable to take and is not so irritating to the gastro-intestinal tract. It is better, therefore, to employ this salt. In cases where it is thought best not to give anything at all by the mouth the drug may be administered per rectum. The use of solutions of gelatin, given subcutaneously, has been quite largely employed for promoting the coagulation of the blood

in conditions such as a thoracic aneurysm and intestinal hemorrhage. I have employed it in a number of cases, without, however, being convinced that it has any value, and its use as a routine measure in the Johns Hopkins Hospital has been discontinued. Pribram and others, however, report good results in small series of cases. If given it should be administered as a 1 per cent. solution, and about 200 cc. of this mixture should be given. Pribram advised 20 cc. of a 10 to 15 per cent. solution, but the use of these stronger solutions is likely to cause a great deal of pain during and following the administration. Great care must be taken that the solutions are perfectly sterile; it is best to sterilize in an autoclave, as several unfortunate cases have been reported due to the presence of tetanus spores in the gelatin. The fluid should be allowed to run in from a bottle through an infusion needle, and should be given deeply into the subcutaneous tissues. In certain cases the gelatin injections are always followed by a chill and sweating; this is independent of any infection, and is apparently an idiosyncrasy, as other patients never have these distressing symptoms. The administration, therefore, of this solution to a patient who is already extremely ill, and oftentimes in collapse, should be undertaken only after very serious consideration. It is only in isolated cases that it may possibly do good.

If the hemorrhage has been very profuse, and the patient is in collapse, the physician may be tempted to adopt measures which are often more heroic than wise. It must be remembered that a certain amount of collapse may be of direct value, in that it may induce a clotting of blood by the reduction of blood-pressure and so close the open vessel. If the collapse is marked, however, and if the patient's life is threatened directly, it is well to give stimulants, such as strychnin and digitalin, even at the risk of causing more hemorrhage. Theoretically, the use of salt solution infusion would be contra-indicated since this, to a slight extent at least, raises blood-pressure, and increases the amount of fluid in the vessels. In cases of extreme collapse, however, it is sometimes necessary to do this in order to save the patient's life, and one should not hesitate to employ it where he feels that it is indicated, reserving it, however, for only the most desperate cases, and continuing its use only sufficiently long to guard against complete collapse.

The **treatment of relapse** differs in no way from that of the original attack. Whenever, during convalescence, there occurs an elevation of temperature all solid food should be stopped at once, and the patient should be placed on the ordinary typhoid fever diet. An effort should at once be made to determine whether this elevation of temperature is due to some complication, or whether it is a true relapse, or merely a recrudescence. In the latter case, the temperature will fall quickly, and after a day or two of the restricted diet one may proceed with the more liberal feeding as before the onset of the recrudescence. If the elevation of temperature is the onset of a true relapse, however, the treatment, including diet, therapy, etc., goes on just as in the original attack, and just as great care must be taken during the convalescence from a relapse as during the convalescence from an original attack.

Treatment of Convalescence.—The correct management of convalescence is just as important as that during the attack; in fact, in many respects convalescence requires greater care, because it is during this time that many of the more serious complications of typhoid fever are likely to occur, and by careful attention to any symptoms that may arise, the physician may detect such complications in their very earliest stages, and so be able to avoid the more serious results.

Special attention must be paid to the diet during convalescence, and it is during this time that the importunities of the patient and his friends are likely to cause the physician the most worry. It is important, however, that he should be firm and not yield to their entreaties if he thinks there is a possibility of harm arising by his doing so. With patients on the strict liquid diet, as employed in the Johns Hopkins Hospital, it is the rule to continue a liquid diet until the tenth day of perfectly normal temperature. After about the sixth day, however, the patients may have broths and warm drinks, and after the eighth day they may also have small amounts of junket and custard. On the tenth day it is well to begin with soft-boiled eggs, and on the twelfth day the patient is given soft toast, jellies, gruel, and puddings. He is not given meat until about the twelfth or fourteenth day, and then one commences with a little scraped beef. In addition he is now given small amounts of potato, rice, oysters, bread, and butter. From the fourteenth day the diet is made more liberal, and at the end of the third week the patient is receiving all kinds of nutritious food, excluding, however, such fruits as contain a large amount of pulp, and vegetables which are likely to cause intestinal disturbances. It is well to continue the milk during the entire period of convalescence, and patients should receive as many raw or soft-boiled eggs as they can take.

Of course, if the patient has been receiving more liberal diet during the entire period of the disease this is continued during the early part of convalescence, and by the tenth day it is advised by those who advocate this form of diet that the patient receive all kinds of nutritious food.

During the first two weeks of convalescence the patient should be kept strictly in bed, and all things tending to cause nervous excitement should be kept away from him. On the twelfth day, if all goes well, he should be allowed to have a back-rest, and on the fourteenth day he may be allowed to sit up in a chair. On the succeeding day he may take a few steps, and from then on he may be allowed to help himself more and more, and, if an ordinary case, at the end of three weeks the patient should be walking about and taking mild exercise.

Of course, the above directions apply to the average case; in the very mild cases or the more severe ones the physician must use his judgment as to what variations in the above rules he will make. It is very important, however, that one proceed slowly and gradually with the increase in diet, even in the very mildest cases, and that all exertion tending to exhaust the patient should be carefully avoided during the first two weeks.

I would emphasize that the physician's duty in the treatment of

typhoid fever does not end when the patient has finished the third week of convalescence. There is no disease in which the effects upon the nervous system are so marked, or in which they may be so distressing, as in typhoid fever, and I feel that cases of neurasthenia and nervous exhaustion not infrequently date the beginning of the trouble from an attack of typhoid fever, following which the patients were allowed to return too quickly to their work. I have seen this time and time again, especially in students and those doing mental labor, and it is just as important, possibly even more so, that the convalescence in these cases should be prolonged as it is in the case of persons who do hard manual labor. In the latter case the persons are usually not able to return to their work until a considerable period has elapsed, but with the former class of cases the temptation is always great to return too early. Convalescence should be at least as long as the disease, and I think it would be better, even in the milder cases, if every patient could rest for at least three months after an attack of typhoid fever. Patients that can afford to do so should be advised to go where the climate is equable, where they can receive good nutritious food, and where moderate, gradually increasing exercise can be indulged in. Patients carrying out these instructions return to their labors after an attack of typhoid fever in excellent physical condition, as a rule, and it is probable that the likelihood of late sequels is materially diminished by this treatment.

Treatment Modified by Preexisting Disease or Complications.—The presence of a preëxisting chronic disease, such as a heart lesion or renal complication, does not modify in any respect the treatment that should be carried out with patients having typhoid fever. Tubbing should be usually carried on with patients having heart disease, just as is done in ordinary cases. In typhoid fever complicated by tuberculosis, judgment must be used in regard to the advisability of employing tub-baths. When typhoid fever is associated with chronic pulmonary tuberculosis the tub-baths had better be omitted, but when associated with acute miliary tuberculosis, or with meningitis, tub-baths may be given, although it is probably better even in these cases to substitute sponges for the tub-baths.

Pregnancy.—The treatment of typhoid fever need not be essentially modified owing to its occurring in a pregnant woman. It is better, however, in these cases to give sponges instead of tub-baths. Pregnancy is interrupted in about 65 per cent. of the cases, usually in the second week of the disease. The typhoid fever in itself is no indication for the artificial termination of pregnancy, however, and there is no evidence that the mother's chances would be improved by such a procedure during the early course of the disease. It is advisable simply to await developments; and with the onset of uterine pains the treatment and delivery should proceed as in an uncomplicated case. During the latter days of pregnancy, however, if labor should occur, the patient should be saved the wear and tear of the second stage. In consequence, the wisest practice is to deliver by an appropriate operation as soon as the cervix is completely dilated. In case signs of exhaustion appear earlier than this, it is most conservative to terminate events by accouchement forcé.

THE SURGICAL COMPLICATIONS OF TYPHOID FEVER

By John M. T. Finney, M. D.

Glossitis and Gangrene of the Mouth.—Glossitis, one of the rarer complications of typhoid fever, usually subsides without special treatment, but in the severer forms may require incision of the tongue. The treatment of gangrene of the mouth is general and local. The general treatment should be that appropriate to all severe pyogenic infections. Special attention should be paid to general hygienic regulations and to the diet, which should be liquid, concentrated, and nutritious. Locally, antiseptic applications and removal of sloughs are indicated.

Stricture of the Esophagus.—Stricture of the esophagus, a very rare complication, may develop during or after convalescence. The usual methods in vogue for the treatment of stricture of the esophagus (see Volume III) should be carried out.

Intestinal Perforation.—Perforation of the intestines occurs in about 3 per cent. of the cases of typhoid fever. It is most common in young adults, corresponding with the period of greatest frequency of the disease; it is relatively infrequent in children. It is more common in men than in women, in the ratio of 3 to 1. Although it may take place at any stage of the disease, it occurs most frequently at the end of the second week or during the third week. The perforation may occur anywhere in the gastro-intestinal tract, but in about 25 per cent. of the cases it develops within the last 24 inches of the ileum, and usually opposite the attachment of the mesentery.

At the lowest estimate at least 95 per cent. of the cases which are not operated upon die, while the mortality in all operated cases may be said to be about 75 per cent. In the hands of some operators, however, this percentage has been reduced to about 60 per cent. or less. It is, therefore, evident that surgical treatment offers practically the only hope in cases of this sort. Of prime importance in estimating the prognosis are the following points: (1) The age of the patient; (2) the stage and severity of the disease and the size of the perforation; (3) the elapsed time between the occurrence of the perforation and the operation; and (4) the organism involved in the causation of the peritonitis.

As to age, it may be stated that children between the ages of eight and fifteen years bear peritoneal infection better than adults. Elsberg has collected 25 cases occurring under the age of fifteen years, with a recovery of 64 per cent. Harte and Ashhurst state that the prognosis is

better in girls between the ages of eleven and fifteen years. The prognosis is worse during the height of the disease than during the first week or during convalescence. Very toxic cases and those accompanied by hemorrhage are extremely grave. A most important point is the time allowed to elapse after perforation before surgical interference. That one should not wait until the symptoms of shock have passed is well borne out by the more recent statistics, which show that the sooner the operation is done the better the prognosis. Elsberg, in his statistics in children, has shown that out of 15 cases operated upon within the first sixteen hours, 12 recovered, while out of 9 operated upon after the first sixteen hours only 4 recovered—a percentage ratio of 80 to 44. This difference is not so striking in adults, but is, nevertheless, quite evident. Harte and Ashhurst's table shows a recovery rate of 27.6 per cent. in operations done within the first twelve hours, while in those done between the first twelve and thirty-six hours it was 20.8 per cent. Another very important factor is the organism concerned; in case the streptococcus is found in the peritoneal exudate, the prognosis is much more grave than in the case of a colon infection, and *vice versâ*.

In view of the foregoing facts, there can be no doubt as to the proper treatment of typhoid perforation, and in cases in which the diagnosis is in doubt, an exploratory laparotomy is justifiable and proper, as it is generally conceded that it influences but slightly the course of the disease if nothing is found. Having decided upon surgical interference, the question which first comes up is one of anesthesia. Local anesthesia has its advantages, at least in exploratory operations, but when suture has to be done and irrigation of the peritoneum is necessary, it has been found unsatisfactory, and usually must be supplemented by a general anesthetic. It is of the utmost importance that an operation of this kind should be very brief, and, therefore, nitrous oxid gas or ether should be used; when properly administered it probably produces less shock than local anesthesia, while, on the other hand, it renders the technic of the operation much easier and more satisfactory and thorough.

The incision should be made over the seat of greatest tenderness and muscle spasm. In the vast majority of cases this is in the right iliac region, and for this situation the longitudinal incision through the right rectus muscle is to be preferred. This gives a good exposure of the cecum, appendix, and lower portion of the ileum, and it can be readily enlarged if necessary. On opening the abdomen, one should first find the cecum and appendix, and next examine the ileum, beginning at the cecum and ascending colon. As much of the fluid as presents in the wound should be sponged out and the rest of the peritoneal cavity packed off with gauze during the process of locating the perforation, in order to limit the spread of the infectious material as far as possible. If the appendix is found to be the seat of perforation, it should receive the same treatment as an ordinary case of appendicitis. If one small perforation is found, it may be closed with a purse-string suture of fine silk and reinforced with mattress or Lembert sutures. The latter should always be placed transversely if possible. In case the inflammatory area about the perforation is ex-

tensive, or the perforation so large that suture would produce a stricture, resection of this portion of the bowel, or an intestinal fistula, will have to be performed. Resection and end-to-end or lateral anastomosis has been advocated by a number of authors, including Harte and Ashhurst, as the operation of choice. Considering the shock which necessarily attends such a proceeding, together with the length of time required to complete it, it would seem to be justifiable only in very few cases, and, in view of the statistics of Escher, should not be compared to enterostomy. Escher advocates in these cases fixing the loop of gut containing the perforation in the abdominal incision. He reports three recoveries out of 4 cases of his own, and in 10 cases collected, 40 per cent. treated by this method recovered. He goes so far as to state that enterostomy is the best method of treatment in all cases. This procedure has the following very logical advantages: It does away with the danger of paresis of the intestinal coils, thus reducing the danger of perforation of other ulcers; it can be done much more rapidly than resection; and it gives the intestinal ulcers a much better chance to heal by drainage.

Another method of treating large perforations which may be mentioned is by suturing the omentum over the opening. This is a very doubtful surgical procedure and is not to be recommended. Having treated all perforations found by one of the above methods, a search should be made for threatened perforations. In case any are found, they should be turned in with a few sutures if time allows; if not, they should be isolated with gauze packing, in order to prevent extravasation of intestinal contents if subsequent perforation should take place.

Keeping the intestinal coils well within the peritoneal cavity during the search for perforations is of prime importance if one wishes to get the best results and prevent shock. Each loop of intestine should be replaced in the abdominal cavity before another is withdrawn. If it is necessary for any reason to keep the bowel out, it should be kept well-covered with gauze pads wet with hot normal saline solution, frequently changed to prevent cooling. Traction upon the intestinal coils should always be avoided. After closing the perforation or perforations, and attending to any threatening perforations, the gauze packing should be removed and as much of the free fluid as possible evacuated. If the peritonitis is localized and the amount of exudate small, gentle wiping off of the fibrin with wet salt-sponges should be employed, but, if the peritonitis is general, irrigation of the peritoneal cavity with large amounts of salt solution is indicated. This, undoubtedly, cleanses the peritoneum better than the wiping method, and at the same time seems appreciably to reduce the shock.

Practically every case should be drained, for the reason that peritonitis has already been established when the abdomen is opened. During the operation a subcutaneous infusion of normal saline solution should be given, together with hypodermic injections of strychnin, etc., if needed. If the condition of the patient is very serious, an intravenous infusion of saline solution should be given. Before the patient leaves the table, while the dressing is being applied, an enema of saline

solution and coffee (200 cc. of each) will be found to be a valuable stimulant.

After-treatment.—The patient should be returned to a well-warmed bed immediately after the operation and kept as quiet as possible, small doses of morphin being given if necessary. Most observers are now of the opinion that in the event of peritonitis the shoulders should be elevated in order to facilitate drainage to the pelvis (Fowler's position). Mayo and others place the patient in a semisitting posture and report excellent results by this method. Infusions of saline solution should be given from time to time; also enemas of saline solution every four to six hours (or after the method of Murphy), not only to relieve thirst, but also to reduce the toxemia and increase peritoneal drainage. There is no necessity for withholding nourishment for twenty-four hours as advocated by some authors, but, on the contrary, it should be begun as soon as the nausea is over, for the patients are necessarily in a very much weakened condition and do not bear starvation well. If a fistula has been left, or in case one should form, the skin should be kept well anointed with lanolin or some similar substance in order to prevent excoriation. In the majority of cases, if the fistula is in the lower part of the alimentary canal, it will close spontaneously. In all other respects the treatment should be that of an ordinary case of typhoid fever.

Appendicitis.—Appendicitis has been observed, in a considerable number of cases, to develop in the course of typhoid fever. The diagnosis is naturally somewhat obscured, but should be determined in the same manner as when it occurs under ordinary conditions, and the same treatment should be employed. After the ileum and cecum, the appendix is the next most frequent site of perforation.

Hemorrhage.—Several years ago we advocated an exploratory laparotomy in cases of severe uncontrollable intestinal hemorrhage, but have been unable to find a suitable case in which to perform it. Dr. J. C. Wilson, at the Atlantic City meeting of the American Medical Association in 1904, advised resort to surgery in such cases. We know of no case which has been deliberately operated upon for the relief of this condition. Harte and Ashhurst mention one which was operated on under a mistaken diagnosis for perforation, a bleeding point found and tied as in the case of hemorrhage from gastric ulcer. Putting the intestine at rest by making an enterostomy would probably be effective and would lessen the dangers of the operation. Ligation or even excision in suitable cases would, of course, be the operation of choice.

Intestinal Obstruction.—The usual forms of intestinal obstruction occurring in the course of typhoid fever are (*a*) functional, due to ileus (adynamic) or paresis from overdistention from gas, and (*b*) mechanical, confined to intussusception. Ross has been able to collect only 3 cases of the latter. It is a question whether there is in typhoid fever a special cause for intussusception. Ross suggests that it may result from a lack of muscular tone due to inflammatory infiltration of the bowel-wall in localized areas, permitting a greater degree of distention

in different portions of the bowel. The diagnosis is always difficult. In Ross' case the operation was done for a supposed perforation. In doubtful cases an exploratory laparotomy is to be recommended.

The intussusception, when found, should be reduced as in any other case. When reduction is impossible, resection and entero-anastomosis or, in desperate cases, enterostomy should be performed. In functional obstructions, where medical measures fail, enterostomy is to be recommended. Dalgleish reports a case of hyperdistention in which puncture of the colon was done with good results.

Liver.—Of the affections of the liver itself, abscess may be said to be the only one amenable to surgical treatment. It occurs usually as a mixed infection, no authentic case of infection with the typhoid bacillus alone having been recorded. The infection may take place in three ways: (1) Through the blood coming from the portal vein; (2) through the blood by the way of the hepatic artery; (3) as an ascending infection in the ducts. It is most likely that the majority of infections take place by the first method, where the infectious material is carried from the intestine or suppurating lymph-glands. Sheldon cites a case in which, at autopsy, there was a direct communication between the abscess cavity and a branch of the portal vein. Infection by this route usually results in the formation of multiple abscesses, while infection by the hepatic artery is more apt to produce a single abscess and to follow abscesses in other situations, such as parotitis, etc. Infection by way of the ducts is very rare, Klebs reporting one case. The trouble usually develops late in the course of the disease and is that of liver abscess.

Liver abscess may heal spontaneously after rupture into the lung, as in Delaire's case, or into the intestine, as in Sidlo's case, but to wait for such an event is a very doubtful procedure. As soon as the diagnosis is made, the abdomen should be opened and the abscess evacuated in one or two stages, according as is found necessary.

Gall-bladder and Ducts.—It is now generally conceded that typhoid bacilli are present in the bile in a large majority of cases of typhoid fever, and are in all probability brought there by the blood to be excreted, and do not, as a rule, enter the biliary passages as an ascending infection. This fact accounts for the relative frequency of biliary complications and sequels. They may also exist in the gall-bladder for a great length of time, as has been shown in a number of cases, Hunner recording one case in which there was a typhoid cholecystitis eighteen years after the attack of typhoid fever. There are also authentic cases in which the typhoid organism has been found in cholecystitis without the patient ever having had typhoid fever. Blumenthal records a case in which he obtained a pure culture of typhoid bacilli from the gall-bladder in a patient who had never had typhoid fever herself, but who had nursed her husband and one brother during an attack of typhoid fever some six or eight years previously.

Cholecystitis With or Without Gall-stones.—The symptoms may be either mild or severe, and may develop during the course of the disease, but, as a rule, follow it. The usual symptoms of cholecystitis are present,

except that they may be somewhat masked by the mental torpor of the patient if they occur early.

If the symptoms of cholecystitis come on during the course of typhoid fever, the treatment should be palliative unless they become severe, in which case laparotomy should be performed and the gall-bladder drained. Tapping should be condemned as an unsafe and unsurgical procedure. The treatment of gall-stones following typhoid fever is the same as that ordinarily employed under other conditions.

Rupture of the Gall-bladder.—Rupture of the gall-bladder is a comparatively infrequent complication of typhoid fever. Erdman[1] has collected 34 cases with 7 operations, of which 4 recovered; the remaining 27 were not operated upon, and all terminated fatally. From this showing it would appear that operation offered the only hope of recovery. Erdman advises cholecystectomy when the condition of the patient permits it; in other cases, cholecystostomy.

Rupture of Mesenteric Glands.—Rupture of the mesenteric glands is one of the rarest complications of typhoid fever which may require surgical aid. LeConte[2] reviews the literature, and has been able to find only 5 cases, and in the discussion which followed 2 others were reported. His article sums up our knowledge of the subject. His conclusions are as follows:

(1) The swelling of mesenteric glands is a constant lesion of typhoid fever.

(2) That such an enlargement is due principally to proliferation of the endothelial cells lining the lymph sinuses.

(3) That these cells, by penetrating the walls of the capillaries and smaller veins, produce thrombosis with resulting minute necroses.

(4) That such necrosis ends in resolution.

(5) That perforation of the capsule of the gland is dependent upon some cause other than the presence of the typhoid bacillus and thrombosis of the smaller glandular vessels.

(6) That perforation is probably due either to the presence of the staphylococcus or streptococcus, or to thrombosis of the larger vessels outside of the gland.

The diagnosis cannot be made with any degree of certainty. The condition is to be differentiated from intestinal perforation, but there seem to be no distinctive signs upon which this differentiation can be based.

The *treatment* is that of peritonitis, and should be varied according to the extent and length of time of the peritoneal involvement. The gland itself should be removed or curetted, and the ulcerating cavity cleansed and drained with iodoform gauze, which should be brought out of the abdominal incision.

Parotitis.—Parotitis occurs as a complication of typhoid fever in the latter part of the disease, and is often of grave significance, being an indication of a general infection. The mortality may be stated to be about 30 per cent. It is relatively more common in males. It is usu-

[1] Annals of Surg., xxxv, 878. [2] Jour. Amer. Med. Assoc., Oct. 22, 1904.

ally a secondary infection, either by way of the duct or from abrasions of the mucous membrane, but cases have been reported which were due to the typhoid bacillus.

The *treatment* should consist at first of cold applications, and, if suppuration occurs, free incision and drainage.

Thyroiditis.—Thyroiditis in typhoid fever is a relatively infrequent occurrence in this country. In Switzerland, where goiter is endemic, it is much more frequent, and in these cases suppuration is more apt to take place. In a large number of cases which have suppurated the typhoid bacillus has been found; in a few cases the pyogenic organisms are the causative agents.

The *treatment* should comprise the use of ice locally, with incision and drainage when suppuration is present. Krause states from observation of a number of cases that a small incision is all that is necessary if suppuration is due to the typhoid bacillus alone.

Orchitis and Epididymitis.—Orchitis and epididymitis may occur either as a complication or as a sequel, the most common time of its onset being during convalescence. It seems to bear no relation to the severity of the disease, and, as a rule, there has been no history of gonorrhea. The testicle is usually attacked first, and in a considerable number of cases alone. In the majority of cases both testicle and epididymis become involved. Both sides seem to be involved with equal frequency, and in only one case were both testicles affected. Infection takes place mainly through the blood, but there are a few cases in which the vas was involved first, pointing to an infection by way of the urethra. The onset and course resemble orchitis, complicating mumps much more than the gonorrheal form. It usually lasts from seven to ten days, and ends in resolution, and may be followed by atrophy. Suppuration has occurred in quite a large percentage of cases, and in these cases a pure culture of typhoid bacilli has been the rule.

The *treatment* should consist of rest in bed, strapping, local support, and ice; and free incision and drainage if the process goes on to suppuration.

Oophoritis and Salpingitis.—Oöphoritis and salpingitis are rarer than orchitis and epididymitis. Many of the cases of oöphoritis occur as infections of preëxisting ovarian cysts, some of secondary infection, and a few in which a pure culture of the typhoid bacillus has been found. The cases of salpingitis are usually associated with the formation of a pelvic abscess. The typhoid bacillus has been isolated in pure culture from a few of these cases. The majority of the cases of infected ovarian cysts and pelvic abscess have occurred some months after the attack of typhoid fever.

The *treatment* should be the same as that for similar gynecologic affections from other causes.

Mastitis.—Mastitis is one of the rarest glandular complications of typhoid fever, and, as in the case of other glandular inflammations occurring in the course of typhoid fever, only calls for the services of a surgeon in case the infected process advances to the stage of suppuration.

McCrae[1] has studied the conditions and has collected all the cases from the literature—21 in all. He finds that it usually occurs late in the attack, it affects both sexes, and is apparently not associated with a functioning gland. It is bilateral in about one-half of the cases. Suppuration occurs in about one-half the cases, and may be associated with the typhoid bacillus and staphylococcus. It has no special effect upon the prognosis of the disease.

Treatment.—The usual local applications—cold, counterirritation, and support—should be used. When suppuration occurs, incision and drainage are indicated.

The Spleen.—Typhoid affections of the spleen are of very little interest to the surgeon, both on account of their extreme rarity, and because, from the nature of the case, very little can be accomplished by surgery. Every case, with one or two exceptions, has proved fatal. It is only when a subdiaphragmatic or perisplenitic abscess has formed that surgery can hope to be of any avail.

When pus is found, it should be evacuated and treated as any other pus cavity.

Pancreatitis.—Moynihan[2] reports a case of typhoid pancreatitis operated upon with the diagnosis of cholecystitis and stone in common duct. He found a pancreas enlarged and of stony hardness. The gall-bladder was drained and the patient made a good recovery. Typhoid bacilli were recovered from it in pure culture. This is the only case recorded of pancreatitis associated with typhoid infection.

The Bones.—Affections of the bones are by far the most frequent of the sequels of typhoid fever. Keen has collected 205 cases. In 51 of these cases cultures were taken which showed Bacillus typhosus to be present in 38. It may, therefore, be stated that in the vast majority of cases this is the etiologic factor, and not a thrombosis or embolism, as was formerly thought to be the case. An interesting point in connection with the bacteriology of these cases is the finding of a pure culture of the organism in sinuses which have been present for years. The relative frequency of this complication may be said to be due to the almost constant presence of the organism in the bone-marrow, even in cases which have shown no evidence of bone infection. That the bacilli may be latent in the bone-marrow for long periods is undoubtedly proved by the occurrence of typhoid bone lesions as long as six or seven years after the original attack of fever. As contrasted with other complications, multiple bone lesions are quite common. The tibia is most frequently involved, then the ribs, sternum, and costal cartilages.

A number of instances are recorded in which a periostitis or osteomyelitis has appeared at the site of muscle attachments, rather pointing to muscular strain as an exciting cause. Cases are also on record in which a recent injury has been followed by bone disease, or it may develop at the seat of a fracture, recent or old. Periostitis is by far the most common form seen, especially in the tibia. There is one rather characteristic form in the tibia in which there is a formation of new

[1] Johns Hopkins Hosp. Bull., Jan., 1902. [2] Lancet, 1903, 1586.

bone in lamellæ between the shaft and periosteum, which can be easily separated from the shaft, leaving it in its original state. Osteomyelitis is seen most frequently in the ribs, together with a periostitis and a chondritis. Usually more than one rib is affected, and the sinuses will be found to enter from the posterior surface. The "shirt-stud abscess," described by Chantemesse, occurring in the tibia, consists of an abscess beneath the periosteum, connecting by a small cloaca with an abscess cavity beneath the outer layer of the shaft. If necrosis takes place, one finds lesions similar in every respect to those of acute osteomyelitis. The pus has a distinctly different color from ordinary pyococcic pus, being dark reddish in color and rather thin.

The vast majority of these lesions take place months or years after the original attack, only very few being recorded as taking place during the course of the disease. Instances are on record in which pain and tenderness were present during the fever, disappeared entirely, and returned months later in the same situation and progressed to abscess formation or necrosis.

An ultimate cure may be promised in almost every case with good functional result, even where repeated operations are necessary.

Treatment.—If treated early with constant applications of ice, the inflammatory process may entirely disappear, as illustrated by two cases of involvement of the clavicle reported by McCrae and Mitchell. When an abscess has formed, it should be incised and all granulation tissue and surrounding soft parts thoroughly removed. At the same time the cavity should be thoroughly curetted or chiseled out until healthy bone is reached.

Osteomyelitis should be treated in the usual manner, and all sequestra and diseased bone removed and the cavity drained.

The involvement of the ribs and cartilages will usually be found to be more extensive than external appearances would indicate, and quite an extensive resection of ribs and cartilages will often be necessary to bring about a cure. Thoroughness is essential to the success of the operation.

In the form of periosteal new-bone formation, already described as occurring in the tibia in lamellæ, it is usually sufficient to incise the periosteum, chisel away the new-formed bone down to the shaft, and close the wound.

Arthritis.—Affections of the joints are occasionally met with in the course of typhoid fever, Keen recognizing three varieties:

(1) Rheumatic.

(2) Septic.

(3) Typhoid proper.

With the first the surgeon is not concerned. The second is fortunately very rare, only a few cases having been reported, and these with few exceptions terminated fatally. The picture is that of an extreme septic condition. The diagnosis is self-evident. The treatment comprises vigorous stimulation and free incisions locally, even amputation in extreme cases. If recovery takes place, ankylosis of the joint is not

an infrequent result. Typhoid arthritis proper may affect one or more joints, usually only one, and that the hip-joint. The lower extremities seem to be more frequently involved than the upper.

Treatment.—Early aspiration or incision should be practised in the distended joints, together with rest and fixation. In other cases rest and fixation alone will be found effective. Dislocations should be reduced by the usual methods.

Laryngitis.—Laryngitis (perichondritis) is an affection occurring in the course of typhoid fever, involving any portion of the larynx, preferably the region about the rima glottidis and the posterior portion of the cricoid cartilages. It may be superficial, involving simply the mucous membranes, or it may involve the deeper structures, the cartilage, etc. There are two forms, the specific and the non-specific.

The specific form is characterized by marked swelling, necrosis, and sloughing, leaving a crater-like ulcer with elevated and infiltrated edges. Typhoid bacilli have been found in a few cases in these ulcers. The non-specific form originates in an ulcer formed as the result of an antecedent laryngitis, which later becomes the seat of a pyogenic infection. The perichondritis which follows is thought to be due to a species of pressure-necrosis combined with pyogenic infection. It may be accompanied by abscess formation.

Laryngeal stenosis from the acute edema and the subsequent cicatricial contraction attending the healing of the ulcer calls for surgical aid.

Treatment.—When the symptoms are at all urgent, prompt tracheotomy for immediate relief is urgently indicated; incision and drainage of any perichondritic abscess should be practised, as well as dilatation of the laryngeal stricture by bougies, tubes, etc.

Otitis Media.—Otitis media is a relatively common complication of typhoid fever. It is always a secondary pyogenic infection, and it is probably a direct extension of a catarrhal inflammation from the fauces and pharynx. It usually occurs from the end of the second to the fourth week.

The *treatment* is that accorded these affections under ordinary circumstances.

Affections of the Serous Cavities.—Inflammation of all the serous cavities, other than the joints which have been previously described, has been observed as taking place in typhoid fever. In a few instances the typhoid bacillus has been recovered in pure culture, but more often the cause is a secondary infection, especially in the case of the peritoneum, where the colon bacillus has been found in the majority of cases. It is not definitely known how the infection takes place. In the case of the peritoneum it is probably frequently by direct extension through the ulcerated bowel wall. In the case of the other serous cavities, the infection probably takes place through the blood current.

The *treatment* is that of inflammations of serous cavities occurring under other conditions.

Affections of the Muscular System.—Affections of the muscles

are rare, and usually occur during the course of the fever. Any of the muscles of the body may be affected, but the abdominal muscles are most frequently involved, especially the recti, more often on the right side. A degeneration of the muscle-fibers takes place, due either to a granular or waxy change which is followed by rupture. The latter condition may be the result of distention, vomiting, straining at stool, or any severe muscular exertion. As a result, a hematoma is formed, which goes on to suppuration in about 50 per cent. of the cases. From some of these the typhoid bacillus has been isolated.

Treatment.—The treatment should consist of local applications of ice and absolute rest, with free incision and drainage when infection has taken place.

Abscesses and Furunculosis.—Abscesses and furuncles occur during the course of the fever, and are frequent complications. They are due to infection with the ordinary pyogenic cocci, and in a few instances to the typhoid bacillus alone. Excepting furunculosis of the skin, the ischiorectal fossa is probably the most frequent site.

The *treatment* differs in no respect from similar ordinary abscesess. Abscesses about the rectum should be opened early and widely on account of the danger of gangrene in this situation.

Gangrene.—Gangrene is a rare complication or sequel. It never occurs as late as the bone lesions, but usually in the third week or during convalescence. Its cause is obstruction of the circulation, either venous or arterial. The factors concerned in the production of the obstruction are weakened circulation, altered blood, and the circulation in the blood of typhoid bacilli favoring coagulation. When the obstruction is due to arterial embolism or thrombosis, dry gangrene is the result; when due to venous thrombosis, moist gangrene takes place. In the vast majority of cases the lower extremities are affected, next in frequency being the perineal region and the external female genital organs.

Treatment.—When the trunk and face are affected, nothing more than removing the sloughs and the application of antiseptic dressings can be carried out. In the extremities, whether amputation should be done immediately, or whether one should wait for the formation of the line of demarcation, depends largely on the condition of the patient. All agree that immediate amputation should be done, well above the probable limit of the disease, if there is grave danger of sepsis or in case the patient shows signs of exhaustion. In other cases it may be better to wait, as it is impossible to tell where the process will stop, and more than one operation may have to be done. An Esmarch bandage should not be used in these cases because of the danger of dislodging a clot, which may give rise to embolism.

PNEUMONIA

By Hobart Amory Hare, M. D.

Croupous, or lobar pneumonia, the common manifestation of pneumococcic infection, is an acute infectious disease characterized anatomically by bacteremia and toxemia and a local inflammation in the lung progressing to consolidation. The designation pneumococcic infection is preferable to croupous or lobar pneumonia, chiefly for the reason that the inflammatory lesions in the lung may be the smallest part of the process going on in the body, and because the extent of the lung involvement has not much to do with the severity of the illness of the patient. It is important to bear in mind that the local lesions in the lung are accountable for some, but not for all, of the patient's symptoms; that the patient ill with croupous pneumonia is suffering from a general infection with the pneumococcus; that organs other than the lungs may harbor morbid lesions at least as well marked as the local pulmonary lesions; that in some cases these other lesions are susceptible of clinical recognition; and that the severity of the clinical manifestations in a given case depends upon the virulence of infecting pneumococcus and the resistance offered by the patient. The extent of the local lesions, be they in the lung or elsewhere, bears no necessary relation to the severity of the general symptoms, which, on the contrary, are an expression of the toxemia.

Pneumonia prevails in all parts of the world, and may be said to be endemic in most large cities. Most cases occur during the winter and the spring. The disease occurs at all ages; it affects males more frequently than females, and the urban more than the rural population; and, while it frequently attacks those apparently in robust health, it is especially likely to attack those debilitated from any cause, such as alcoholism, etc. An etiologic relationship with exposure to the inclemencies of the weather, to "catching cold" (reduction of the vitality of the system), is undoubted. Recurrences are common. Small epidemics are not infrequent. Infection is usually acquired by inhalation, the lung being first involved. There is some evidence, however, that the blood may be primarily infected through a wound or the tonsil, for instance, and the lung or other organ secondarily involved.

The pneumococcic process consists of a productive inflammation, leading to consolidation of a portion of a lung, usually one lobe, sometimes two lobes, or portions of both lungs. In consequence of this con-

solidation, so-called hepatization, the respiratory surface of the lung is much reduced, whence dyspnea and cyanosis result; and, in consequence of the increased pressure in the pulmonary circulation, cardiac embarrassment results, although, contrary to former opinions, it seems to be conclusively proved that the major factor in producing cardiac embarrassment is the toxemia acting upon the cardiac nervous mechanism and upon the myocardium, producing degeneration, weakness, and dilatation. The natural tendency of pneumonia is toward spontaneous recovery, crisis occurring in the majority of cases on from the fifth to the ninth day of the disease. Concurrent with or soon after the crisis the pneumonic exudate undergoes softening and is removed, largely by absorption, partly by expectoration. In some cases the crisis is delayed or it may be replaced by lysis; occasionally defervescence does not occur, the process going on to abscess or gangrene of the lung, or a chronic interstitial process may supervene. Many anomalies in the onset and the course of the pneumonia are frequently encountered—anomalies suggested by the terms epidemic, migratory or creeping, massive, terminal, postoperative (or ether) pneumonia, etc. Complications, especially inflammations of the serous membranes, such as pleuritis, endocarditis, meningitis, etc., are common; bronchitis, gastritis, colitis, phlebetis, myocarditis, nephritis, etc., are more rare. Sequels are unusual, but, as already mentioned, abscess or gangrene of the lung or chronic interstitial pneumonitis, etc., may supervene.

The mortality varies between 20 and 40 per cent., depending upon the virulence of the infection and the resistance of the patient. In the majority of fatal cases death results directly from the toxemia, but in a minority of cases to this is added an unusual embarrassment of the heart, induced not only by toxemia but also by the mechanical obstruction in the pulmonary circulation or heart-clot.

In unusual cases, the pneumonic process is set up by microörganisms other than the pneumococcus, such as Friedländer's pneumobacillus, the influenza bacillus, the typhoid bacillus, the plague bacillus, the streptococcus, the staphylococcus, etc., but the processes induced by these organisms differ somewhat anatomically as well as clinically from true pneumococcic infection of the lung.

Bearing in mind the natural tendency of pneumonia toward spontaneous recovery, and knowing that the fatalities are due to toxemia and to embarrassment of the circulation, we have reason for believing that by devoting especial attention to the relief of the toxemia and to the support of the circulation, as well as to other indications for treatment as they may arise, we may add to the recoveries patients who otherwise would succumb to the infection.

PROPHYLAXIS

Croupous pneumonia being a distinctly infectious malady, it is evident that it is the duty of the physician to exercise prophylactic measures whenever it is possible to do so. Such preventive measures deal

with the destruction of the pneumococcus, the protection of the individual from its invasion, and the maintenance of conditions which will at least serve to render the patient resistant to its attacks.

The first measure is to be gained by carefully destroying all the discharges which come from the respiratory passages, by burning the rags upon which the patient expels nasal or other discharges, or by placing in the spit-cup a sufficient strength of bichlorid to be efficient. The glutinous sputum should be stirred and mixed with the disinfectant in order that every part of it may be acted upon. Great care should be taken in regard to the disinfection of the sheets, pillow-cases, and blankets used by the patient, and of the carpet as well. Even careful patients, watched over by excellent nurses, will often unavoidably and unconsciously infect their surroundings by coughing or sneezing, and thereby expel the infecting organism in minute droplets of discharge. For these reasons, all bedrooms inhabited by pneumonic patients should be well disinfected after convalescence is established.

The second measure, namely, the protection of the individual from invasion, is often difficult or impossible. Those who are of advanced years, who are feeble from chronic ailments, particularly from renal, cardiac, and bronchial affections, should be carefully excluded from the sick room. Whether the patient is nursed by relatives or trained nurses, they should be given plenty of rest, sleep, and fresh air during their attendance, since by these means their resistance is increased.

The third measure consists in directing those not affected by the disease, but who may be exposed to its infection, to be careful to avoid cold and wet, to be careful as to adequate clothing, and to avoid excessive nervous, mental, or physical fatigue. These rules are particularly important in cases of renal disease or of feeble heart after attacks of influenza, and if possible the patient who suffers from these troubles should avoid exposure by residing in the winter months in a salubrious climate, such as is found in the South and southwestern parts of the United States.

TREATMENT

The patient having been taken ill with the malady, what plan of treatment shall be followed?

From what has been said of the etiology, morbid anatomy, and general history of croupous pneumonia, it must be evident that several propositions hold true in regard to its treatment. Some of these may be stated in the following terms: (1) The physician must never forget that the illness is the result of a general infection in which the chief lesion is situated in the lungs. (2) That the disease is, at least so far as the pulmonary lesions are concerned, distinctly self-limited, thereby resembling other diseases which we have been in the past more wont to call acute infections, such as the various exanthemas. (3) That in a large proportion of cases the malady or infection is a complication or terminal infection, or, in other words, that its existence depends upon the presence of a

condition which, to a greater or less degree, diminishes vital resistance, and so permits the ever-present pneumococcus not only to gain a foothold, but, in addition, to do serious damage and perhaps cause death. All of these three points are of importance, but the last is perhaps the most important from the standpoint of the physician, because if it is always borne in mind the practitioner will approach the treatment of the case with a wider conception of its scope, will seek, and, therefore, probably find, some hitherto hidden, unknown or unsuspected state, which by reason of its existence will largely control his plan of treatment, strongly affect his prognosis, and, what is equally important, at least from the standpoint of the physician, enable him to determine the real value of the plan of action which he institutes in each case. If every case of croupous pneumonia is to the physician merely an instance of consolidation of the lung, followed by death or resolution at the end of a week or ten days, then he will almost certainly fall into one of two errors. If his cases get well on a certain plan of treatment he will congratulate himself on his skill, and if a goodly proportion die, he will suffer, according to his temperament, from more or less chagrin and doubt as to his therapeutic acumen. As a result, he may fail to adhere to a plan which is based on sound sense, and he may turn to one less logical and not founded on experience. Whereas, if he recognizes the fact that in some of his cases the existing conditions are such that no plan of treatment can succeed, or at best can only do so by the most careful nursing, he will obtain a perspective or broad view of the course of the disease and the results of the treatment which will make clear the need of modification to suit the individual without impairing the general plan he has found to be the best. The physician in the latter case is like the mariner who, having worked out his course, finds it necessary to make minor changes because of wind and wave; whereas the physician who fails to gain a clear conception of the whole state of his patient, in each instance is so harassed by head winds and unexpected seas that he may find himself buffeted by conflicting factors to such an extent that he is soon sailing an uncharted sea without the compass of experience or the sextant of observation. It is largely because of these facts that so many plans of treatment of infections in general, and pneumonia in particular, are advanced. Each man in the face of a certainty has a plan of his own for escape, and some succeed by the aid of, or in spite of, nature, while others fail. It is by no means rare at a medical meeting to hear the treatment of croupous pneumonia discussed with minute detail as to drug and dose and no detail as to the age, state, general health, and vital resistance of the patient. The statement of drug and dose is useful, but it is of little real value unless we are told that the age of the patient was favorable or unfavorable, and unless we know, for example, that the kidneys and vascular system were not affected, and that the patient was not addicted to alcohol. There still remains another factor to be discussed in all debates on this subject; namely, the virulence of the infection and the site and size of the lesions. Every one of experience knows that he may see a series of cases of croupous pneumonia in which a large area of the

lung is affected, yet in which the patients are never very violently ill or in great danger, and every one also knows that not rarely a small area of pulmonary disease may be so insignificant as to be completely overshadowed by the severity of cerebral, meningeal, or renal symptoms The plan which succeeds in one series may totally fail in another, yet it may be excellent so far as its basic principles are concerned.

Having expressed the general facts governing the therapy of this infection, attention may now be turned to the treatment suited to nearly all cases, and after this, to the plans which are to be applied to special emergencies, unusual conditions, or complications.

Hygienic Measures.—The almost universal belief on the part of the laity that pneumonia is due to cold has led to the fatal custom of smothering these patients with close air and an inordinate amount of body clothes and bedclothes. The sufferer not only suffers from the diminished respiratory ability of his lungs, but he is starved of oyxgen and suffocated by the excess of exhalation products in the air. He not only must exercise his respiratory muscles to excess to get sufficient air, but he must also lift with each breath a weight of covering which he would find insufferable in health. On the other hand, the custom, in some hospitals in particular, of depriving the patient of his customary clothing is an unnecessary hardship and may interfere seriously with the activity of his skin and kidneys. Fever is reduced so little by inadequate clothing, it is so harmless in itself, that so feeble an antipyretic measure should not be resorted to if any real need of antipyretic measures exist. The physician should impress upon the nurse and friends the fact that a supply of fresh air, as liberal as is found in a tent, should be given every patient suffering from pneumococcic infection, particularly if that infection has chiefly attacked the lungs. Even a draught is better than a scanty breath of air.

The second factor in the hygienic series is that of feeding. Experiments, innumerable and practical experience beyond estimation, have served to impress us with the important fact that properly assimilated food means increase in vital resistance, yet in many instances this fact is ignored, either because it is forgotten or because the physician is misled by the plausible purveyor of expensive, but almost useless, artificial foods, and by his own ignorance of how to prepare easily digested food-stuffs for his patient. What consultant has not seen patients skilfully treated by drugs, starved by the use of peptones or peptonoids, which if carefully examined would not yield calories sufficient for a small animal, and if evaporated to dryness would be almost devoid of residue. The two absolute essentials as to the food in this disease are that it shall be in itself adequate, and in such a form that, barring digestive disturbance, it may be digested and absorbed and utilized by the body with the least possible expenditure of energy in the process of digestion. So far as proprietary foods are concerned, a mere statement as to the results of chemical analysis may be most misleading. A few years since a food for phthisical states was widely advertised, statements were made as to the calories or heat units it contained, and

so far the absolute truth was told. As a matter of fact, it was nothing but commercial glucose of a poor grade; that is, a form of material from which the organism could obtain calories only with great difficulty and labor. The foods that are particularly useful in these cases will be found in the article on dietetics, but it may be worth while to state that the articles should be varied if possible and that each feeding should be of a different character. There is no more reason, in the majority of cases, why milk alone or broth alone should be given than that a healthy man shall subsist on one article of diet for several days at a time. As I have pointed out in regard to typhoid fever, and as Croftan has emphasized in regard to renal disease, we cannot expect adequately to nourish a sick man by means of milk alone. To give him the needful number of calories or heat units in twenty-four hours he must take between $3\frac{1}{2}$ and 4 quarts of milk, an amount which not only distends the stomach, but overwhelms the kidneys in their effort to excrete this large quantity of fluid. There is nothing so harmful for a patient ill of this malady as to have the stomach disturbed and overloaded. Again, milk is a form of food well qualified to cause flatulence, and tympanites is a complication much to be dreaded. For these and other reasons it is evident that, although milk is a valuable article of diet, it is not to be depended upon alone, but used as an adjuvant. Somewhat similar objections hold true in regard to animal broths, which possess, in addition, extractives of animal tissues, which in a nearly related form the system is endeavoring to eliminate as a result of the fever, and which also contain a very small amount of solids for the bulk of fluid which must be swallowed to get the proper proportion of nutriment. Broths must not be depended upon to any great extent, yet they fill an important rôle in the care of the patient. The food-stuffs that offer the greater quantity of nourishment for their health, if properly prepared, and which can be readily utilized by the economy, are broths or gruels made from the vegetable kingdom, the digestion of which can be aided by the simultaneous use of pancreatin or taka-diastase to convert them into sugars. Further than this, these preparations also provide the body not only with carbohydrates, but, because of their gluten, present a moiety of nitrogen. Carefully cooked, well seasoned, partly predigested gruels are, therefore, in my experience, one of the best forms of food for these cases, the gruel being made of rice, barley, wheat, and, rarely, oatmeal. If the patient is fed every two hours with a small cup of milk, broth, or gruel, his circulation is at no time hindered by a full stomach, he receives an adequate quantity of support, and is not disgusted by a constant sameness of diet, which finally becomes nauseating. Some patients also do well if they are allowed their morning cup of coffee or their afternoon tea, although it is, of course, a fact that the illness and the fever may, and usually does, destroy all desire for food and customary drinks. The point is that there is no harm in these things if they are desired, and as both these beverages if stopped result in depriving the patient of accustomed stimulation, they may do good if permitted. In other words, a more generous and varied diet is being urged in this article,

great care being taken that it is not carried to a point at which assimilation does not occur. There are many cases so acutely and desperately ill, and which run so brief a course, that any plan of feeding is impractical; but there are others in which the critical period does not arrive for some days, during which time much may be done by proper feeding to increase the vital resistance of the individual. This is particularly the case in those of advanced years and in persons who have been addicted to the use of alcohol to excess.

What can be done by the physician to arrest or diminish the development of toxemia? To this question the reply must be that aside from the general measures already described we can do little if anything. It is not necessary at this point to burden this work with a long résumé of the various specific sera which have been advanced as cures for this infection. The fact is, that their use has given us no better results than other plans of treatment, and in some instances the results have not been as good. It is also a fact that no remedies yet discovered, whether given by the stomach or inhaled into the respiratory passages, diminish the activity of the organism of infection either as to its multiplication or genesis of toxin.

The free drinking of water and the occasional use of alkaline diuretics may be resorted to for the purpose of keeping the kidneys active in the elimination of the normal and abnormal excretory materials which are developed in the patient by the disease and its accompanying fever.

We come next to the **treatment of certain predominant** symptoms which demand our attention in the early stages of the disease. When the disease is ushered in by a rigor, the patient may be given a hot drink and be supplied with heat from hot bottles. Beyond these measures nothing can be done. With the onset of the fever, pain, and excited circulation, the physician is brought face to face with problems which have taxed the discovering powers of physicians for years. It may be stated emphatically that no therapeutic measure is necessary in most cases for the fever. It has come to be a well-recognized fact that the use of the so-called antipyretic remedies is not only not advantageous, but often positively harmful. Their use is, therefore, to be carefully avoided, and particularly so in the old and feeble and those who have an impaired heart or kidneys. The use of cold water or hydrotherapy is less deleterious, but rarely advantageous. There are practical and theoretic reasons for its avoidance. First, experience has taught us that cold baths are usually badly borne by these patients; and, second, there are good reasons for believing that the fever is not only a manifestation of the illness, which is unimportant, except as a gauge of its character, but that it may be positively advantageous in its effect in aiding the economy to withstand the illness. Many of these facts can be found in a paper which I wrote many years ago under the title of the "Rôle of Fever in the Cure of Disease."

Cold applications to the head in the form of ice-compresses or an ice-bag may be used with advantage to diminish headache and perhaps to decrease the tendency to delirium, and so promote sleep.

In the relief of pain in the early stage of the disease the physician may perform his best office in his care of the patient. If the pain is very severe, relief should be given by the hypodermic injection of $\frac{1}{6}$ gr. of morphin, with which may be given $\frac{1}{200}$ gr. of nitroglycerin to prevent morphin nausea the next day. In other cases, particularly if the skin is very hot and dry, Dover's powder in 5- or 10-gr. doses may be given as often as it is necessary to control the pain without stupefying the patient. A third excellent method of giving relief is to strap the chest with strips of zinc oxid plaster, $1\frac{1}{2}$ to 2 inches wide, extending from the spine to the midsternum, or at right angles to the spine, not following the line of the ribs. This does good by limiting the movement of the affected side. Not rarely the application of a large ice-bag or even an ice poultice to the chest over the affected area will markedly decrease the pain of the associated pleurisy.

The plan to be followed in the treatment of the circulatory state in the stage of onset differs greatly in the hands of different physicians. At one time, largely through the teachings of H. C. Wood, it was customary with many to employ aconite, veratrum viride, or antimony, as vascular and cardiac sedatives, with the idea that by so doing the supply of blood to the engorged pulmonary area was diminished and the man "bled into his own vessels.' Long before this plan was advocated tartar emetic and venesection had been heroically employed. At the present, those who employ depressants in the early stages of acute pneumonia are rarely met with. The chief reasons for the decrease in popularity of this plan are, first of all, the general recognition that the state of the patient is the result of an acute infection involving the whole system, although chiefly manifested by pulmonary lesions. In other words, the state is not a simple physical or mechanical engorgement of the lung with blood followed by exudation, but, on the other hand, is the result of perverted functional activity of the vital processes in general under the influence of the pneumococcus and its toxins. Another reason for the diminished popularity of the depressant method is the fact that it is at best only suited to a very small proportion of cases, and in these only when the patient is seen in the very early stages of the malady, and when his condition is very sthenic and the circulation really full and bounding Often a full pulse in the early stage of pneumonia is really gaseous, when thought to be strong. Again, if the attack is secondary to some pre-existing and devitalizing disease, as is so often the case, the use of depressants is manifestly unwise, and the time for their use, even if it ever existed, is passed while the physician seeks by careful study to discover the existence of such maladies. As a matter of fact, all necessary sedation of the circulation can be obtained in most cases by the use of an ice-bag on the heart and the use of Dover's powder.

The control of cough, if it is sufficiently frequent to cause pain or exhaustion, is best attained by the use of Dover's powder or by $\frac{1}{12}$-gr. doses of heroin or $\frac{1}{4}$-gr. doses of codein. These remedies also control within reasonable limits the nervousness and restlessness which are often

troublesome symptoms. In cases in which delirium is sufficiently violent to exhaust the patient, they are not powerful enough, and the bromids are usually also too feeble. Chloral is too depressing, and the physician should not be afraid, if he believes that the delirium is really exhausting the patient, to give morphin hypodermically with a liberal hand. Not rarely a few hours of sleep will produce a clear mind and physical rest which is most salutary. Persistent insomnia should be treated in a similar manner.

When the disease has advanced to its well-developed stage the treatment of the various symptoms already named still maintains, but the question of the circulatory state and the general health becomes the dominant factor for the physician's consideration.

It is exceedingly important for the physician to bear in mind a fact at this period of the illness; namely, that he must be a passive spectator unless some definite condition exists which demands treatment. The patient, his friends, and the physician are all so anxious to see recovery speedily and certainly ensue that they are far too much inclined to resort to active medication when none is needed. As I have said elsewhere, consultants are often amazed to see how well a patient survives the attack of the malady abetted by the well-meant endeavors of the physician and friends. In pneumonia the motto should be "let the patient get well," and give drugs only when they are indicated, and surely indicated, to meet a special taste. The mental attitude of the physician should be one of protest against drug giving, although when real need exists he must often be heroic in his use of medicines. The proposition as to the circulation is not "it must be stimulated," but rather "does it really need stimulation?" and if so, how much is needful? In order to determine what is really needed the physician must find if the first sound of the heart possesses its normal tone, and if the apex-beat is normally forcible and in the proper place, and he must allow for the presence of the illness as a natural cause of perversion of function, and not as a manifestation that the heart is seriously impaired. He must listen with care at the third left costal cartilage to discover if accentuation of the pulmonary second sound indicates an abnormally high pressure in the pulmonary artery, threatening failure of the right heart, and he must listen for the aortic second sound to discover if the fever, or other cause, has produced such a state of arterial pressure that the left ventricle is called upon to do too much labor. Finally, his fingers upon the pulse must give him additional information as to arterial tension, pulse force, and pulse rhythm. If the results of all these tests is the discovery that nothing evil exists, let the medical attendant carefully eschew the use of drugs. If, on the other hand, he finds that the first sound of the heart lacks quality, he is called upon to use a stimulant, and he must determine which is most needed. The need of a stimulant becomes still more emphatic if the second pulmonary sound is accentuated and if the pulse is arrhythmic or if it misses beats. The choice of the drug depends in part upon the age of the patient, his general vitality, and, very important, the stage of the illness and the

duration of the evil symptom. In the aged, if the arterial tension is not too high, digitalis is necessary, giving it often in small divided doses to avoid irritating the stomach; or, in its place, one of the alcoholic stimulants is often needful, The latter are absolutely essential if there is a history of the free use of this form of stimulation before the illness. These remedies may be needed in younger patients, but they are less and less necessary as youthfulness exists, and it is often the case that the skilful physician can, by the use of some rapidly acting diffusible stimulant, give such support to the circulation that he may bridge over a temporary distress and get his patient into smooth water "on the other side of the reef," where he may progress without any further use of drugs unless he gets in some acute difficulty a second time. There is surely no more reprehensible practice than the ordering of large quantities of medicine to be taken day after day in pneumonia as a matter of routine. What captain would think of giving orders for the handling of his ship for the next twenty-four hours. He expects to be constantly on the watch to see what changes occur and to fit the orders to the needs of the moment. Of the rapidly acting diffusible stimulants three surpass all others; namely, Hoffman's anodyne, aromatic spirit of ammonia, and strychnin. They may be used alternately, or, if the condition is pressing, all together, but the first two are more speedy in their effects than the last. The doses vary with the gravity of the state to be met, and the same statement holds good as to the frequency of their use. All these drugs are to be given freely for a brief time, not at intervals of several hours. Used in the latter way their influence is of little value, they soon lose their good effects, and the physician finds himself deprived of his ablest allies when another period of depression or collapse ensues. Further than this, the anodyne and the ammonia, if their use is persisted in for more than twenty-four hours, usually seriously interfere with the functions of the stomach. The opinion that the continued use of ammonia in these cases in any way decreases the danger of a heart-clot is very doubtful, and is without foundation on a scientific bases.

I have, on a number of occasions, called attention to what I believe is the very general abuse of strychnin as a circulatory stimulant. It is, without doubt, the custom of a large number of practitioners to rely upon strychnin as a stimulant to the heart during the course of the acute infectious diseases, and not only to give it for a few days at a time, but to continue its administration day by day and even week by week, with the result that the patient may be benefitted during the earlier part of its administration, but soon fails to develop any good effects from its use, and, on the contrary, suffers from a condition of circulatory and nervous irritability which is often taken for a manifestation of the disease. There can be no doubt that full or even massive doses of strychnin are exceedingly valuable in their effects in cases of acute circulatory failure, and even in many cases of subacute circulatory failure such doses may not only improve the patient's condition, but actually save life, it being the consensus of opinion among medical men that

massive doses of strychnin are very certainly life-savers when cardiac failure is threatened.

To sum the matter up in regard to strychnin, it may be said, as of all powerful drugs, that used wisely and in proper cases it is an efficient remedy, but that used unwisely it is as capable of doing harm as any other powerful agent, and, therefore, its use should not be begun nor should its administration be continued unless there is some excellent reason for it. When strychnin has been given for more than a few doses the physician should carefully catechise himself as to whether it is still needed, and as to whether some of the symptoms of rapid pulse and nervous irritation are not due to its use. Strychnin is to be regarded as an active nervous stimulant, to be used to combat any signs of failure in vitality and then kept for the next period of collapse.

Something must be said about the use of digitalis. This drug, although it is the most powerful of all our cardiac stimulants, is capable of doing much less for the failing heart of acute croupous pneumonia than for that of valvular disease. There are several reasons for this. Among others, it is well known that digitalis does not produce its full physiologic effects in the presence of fever, and is unable to produce a good effect if the myocardial fibers are degenerated by the toxemia of the disease. When the fever is high the drug cannot be greatly relied upon and may be entirely useless, and when the toxemia is severe, it may fail utterly. In other words, given two cases of pneumonia, one may be greatly benefitted by the use of digitalis, because the symptoms of circulatory failure are due to cardiac fatigue and loss of power due to this cause; the other case may obtain no relief because the heart is poisoned by the infection. Again, the use of digitalis to support a tired heart in a person with sclerotic vessels, without the simultaneous use of nitroglycerin to reduce arterial tension, may do more harm than good; or, on the contrary, its use in a case of cardiac failure, associated with vascular relaxation of a severe type, may prove of little value unless some other drug is used, as, for example, atropin, to help the digitalis improve the vascular tone and restore the equilibrium of the circulation.

Not rarely, the placing of an ice-bag over the pericardium when the action of the heart is too rapid will not only greatly improve its action, but apparently increase the favorable effect of the digitalis, which may be simultaneously used.

Although the fact is not generally recognized, digitalis is very variable as to its physiologic activities, and there is no drug upon which so much depends which can be so little relied upon if it is not tested and proved active. I have no doubt that many disappointments as to the effects of its use in this and other diseases depend upon this fact. It is, therefore, essential for the skilful use of digitalis that a preparation of it should be employed which is in every sense standardized and tested, being neither more or less active than that which is commonly employed by physicians. In the endeavor to obtain such a constant product physicians have used the various glucosids and other

active principles which can be obtained from digitalis leaves, such as digitalin and digitoxin, and numerous contributions to medical literature have been made with the object of proving that these active principles really represent the true value of the drug. As a matter of fact, large experience has proved to the satisfaction of most members of the medical profession that these isolated substances do not represent the full therapeutic value of digitalis leaves, and as a result most physicians still resort to the fluidextract, the tincture, or the infusion when they are called upon to treat diseases of the circulatory system which demand the use of this drug. The popularity of this infusion is undoubtedly on the wane, since, of all the preparations of digitalis, it is the one which is most prone to disorder the stomach, although there are some reasons for believing that it possesses diuretic properties which are not found in the alcoholic preparations. Even these galenical preparations of digitalis, however, often fail to produce the satisfaclory result which is desired. In some instances they produce little or no effect, in others an excessive effect, and in some the influence which is exercised is manifest, but not favorable. A reason for this exists in the unavoidable variation which occurs in the strength of the digitalis leaf as it grows in different places. Whether the English, American, or German leaf is employed, there is still very considerable opportunity for variation in physiologic activity to exist, and as a result the physician is often disappointed in finding that the dose which he ordered does not meet the needs of the individual case. As is well known to our readers, digitalis is a substance which does not lend itself to chemic analysis, and, therefore, it is impossible for manufacturers of fluidextracts or tinctures to assay it and determine its actual strength. The consequence is that it is impossible for a physician to obtain a standard preparation of this drug unless it has been subjected to a physiologic test by those who are skilful in studying its effects upon animals. With such a preparation fairly certain results are obtained if it is administered skilfully. Attention has been called to this matter once more by Hardman,[1] who points out that in his experience some specimens of digitalis are very deficient in active principle and exceedingly inert. He also adds that digitalin, which is a term rather loosely applied to a complex substance, often does not exercise the effects which are desired, and as an illustration of the lack of reliability of this product he tells us that he recently obtained a number of pills containing $\frac{1}{50}$ gr. each of digitalin. The first night he took one; the next, two; the next, four; and the next, five; in other words, the equivalent of $\frac{1}{10}$ gr. of digitalin in the last dose without any effect whatever being produced. He then proceeded to take seven in one night, and the next night ten, or, in other words, $\frac{1}{5}$ gr. of digitalin. The only result of a dose of ten pills was some gastric discomfort, but not the least effect on the circulation. On the other hand, he found that when he took a comparatively minute dose of what is known as Nativelle's digitalin he got an effect which was so marked that he did not care to go beyond this dose, and, on further

[1] British Medical Journal, September 16, 1905.

inquiry, he discovered that the first digitalin was made in Germany, and that the so-called Nativelle's digitalin was really digitoxin.

The hypodermic administration of the tincture usually produces little physiologic effect, causes great pain, local induration, and much subsequent tenderness, because, in all probability, the juices of the tissues precipitate the ingredients of the digitalis which are insoluble in a watery solution. A new preparation, known as digitalone, which is physiologically active in doses varying from 5 to 20 drops, when administered hypodermically produces excellent results and no untoward effects. As this digitalone not only possesses these advantages, but is tested pharmacologically to determine its physiologic activity, it is manifest that it possesses marked therapeutic advantages.

If a full and immediate effect of the drug is needed, a first dose of 20 drops of digitalone may be used hypodermically or given by the mouth, or 2 to 5 minims of the fluidextract may be given by the mouth; or, again, 15 to 20 minims of the tincture may be employed. The effect of the drug is then maintained by smaller doses, given at gradually increasing intervals to maintain its effects.

I am firmly convinced that some cases of cardiac irregularity met with in the course of this disease are due to overstimulation, due to too much digitalis, and not to the effect of the malady.

Much misunderstanding of the proper use of nitroglycerin exists. I have repeatedly pointed out that the very common employment of nitroglycerin by the profession as a circulatory stimulant is based upon an erroneous conception of its physiologic action, and when good results have followed its administration in cases of cardiac failure, which are not due to high arterial tension, the physician has given credit to the nitroglycerin, when, in reality, the credit should be given to the recuperative powers of the patient It is not conceivable that nitroglycerin can be of benefit by lowering the arterial tension of a patient whose blood-vessels are naturally elastic and whose blood-pressure is practically normal or below normal, yet, as I write this article, I read the opinion of a well-known specialist in diseases of children, who advises the use of nitroglycerin in infants who may be suffering from circulatory embarrassment due to pneumonia. It is quite true that in some of these cases when the skin is hot and dry the administration of a drug which will relax it and produce mild diaphoresis is followed by good results, but the good effects which follow this plan of treatment are due to the equalization of the circulation in various portions of the body, and do not depend upon any stimulant effect upon the circulatory or nervous system. Sweet spirit of niter, which has a physiologic action closely allied to nitroglycerin, seems a much better remedy than the more powerful drug, nitroglycerin, if any vascular relaxant is needed.

In regard to the use of atropin, there can be no doubt that it is a most valuable remedy in the later stages of the disease when collapse develops. It has long been thought that this drug is an efficient vasomotor stimulant in the sense that it causes a general rise of arterial pressure, While its use produces such a result in the laboratory, I am inclined to believe

that it does good in the circulatory difficulties of pneumonia by aiding in the reestablishment of the circulatory equilibrium; that is, by equalizing blood-pressure in all parts of the body. I have frequently seen its free hypodermic use check the leaking of the skin and restore the flagging pulse at the same moment that its full physiologic effect was manifested by the intense hyperemia of the cutaneous vessels, which causes the flushing so characteristic of its action. In addition, it aids in checking the excessive secretion of mucous which in some cases adds so much to the respiratory difficulty of the patient. As the action of the atropin or belladonna is fleeting, and that of digitalis prolonged, it is usually wise to give it twice as often as the latter drug, and, if need be, to give it hypodermically. Atropin, like many of the other remedies already named, is not to be used day after day as a matter of routine. If so used it will lose its power, disorder digestion, and so dry the mouth and throat as to cause great discomfort.

The use of expectorants in pneumonia is, in the great majority of cases entirely useless and often harmful. It is one of the regretable facts of general practice that the physician rarely sees autopsies, and, as a result, his conceptions of pathologic processes becomes distorted or clouded. No one who sees the "carnified lung" at any stage of its career can possibly imagine that squill, ipecac, or other so-called expectorants can possibly aid the patient. Resolution progresses uninfluenced by these drugs, and even remedies with greater alterative power, such as the iodids, are probably incapable of exercising a beneficial effect. In the vast majority of cases the improvement which follows the use of a compound expectorant mixture lies in the control of an excessive cough by the sedative which is administered. The sedative does the work and the squill or senega get the credit. Equally good results will be obtained by the use of a sensible administration of a little codein or heroin if the cough is annoying and is a destroyer of rest. There is no excuse for burdening the stomach with remedies to be absorbed, and the kidneys with drugs which have to be eliminated, when both these parts have enough to do because of the illness. In the stages of resolution the use of expectorants to relieve a persistent bronchitis may be advantageous. If such a drug is needed, ammonium chlorid is probably the remedy of choice in 5- to 10-gr. doses.

I wish to sound a note of warning against the use of iodid for this purpose. The processes of nature are best suited to the removal of the exudate in the vesicles of the lung. The iodids may hurry these unduly, and may in the general process cause an absorption of some old inflammatory mass which has walled off and rendered innocuous an old tuberculous deposit. In cases in which delayed resolution is present, and the physician is tempted to hurry it by the use of the iodid, he too often finds that the delay is not due to the remains of a frank pneumonia, but is the result of a terminal or coincident infection by other organisms, and the officious interference of the physician when nature is endeavoring to produce good results may be followed by disaster.

During convalescence the chief remedies are fresh air and sunshine.

Any tendency to anemia is to be combated by the use of moderate doses of iron and arsenic, and if auscultation reveals feebleness of the heart a little digitalis and nux vomica should be used. I say a little digitalis with intention. It is not useful at this time to strongly stimulate the heart. What is needed is gentle stimulation, to an extent which will increase the cardiac tone by a gradual influence, and, therefore, 2 or 3 minims of the tincture of digitalis of the United States Pharmacopœia of 1905 will usually be ample. If the older tincture is used, an even smaller dose is sufficient if given three times a day for a week or more at a time.

DIPHTHERIA

By George H. Weaver, M. D.

Diphtheria is an infectious disease caused by the diphtheria bacillus. While undoubtedly known in ancient times, diphtheria was first clearly recognized as a disease *sui generis* by Bretonneau, and so described by him under the name "diphthérite" in his classical memoirs,[1] the first two of which were read at the Académie Royale de Médecine in 1821. The essential pathologic anatomy, contagious character, clinical course, and treatment, including tracheotomy, as first described by Bretonneau and his pupils, among whom were Velpeau and Trousseau, were so completely and accurately treated that little was subsequently added, until the "special germ" which Bretonneau had suspected was discovered by Klebs in 1883, and obtained in pure culture by Löffler in 1884. Diphtheria is characterized by a pseudomembranous exudate upon a mucous membrane or the abraded skin, in which exudate Bacillus diphtheriæ is always present. The mucous membranes most often affected are those of the throat and larynx, but the infection may extend from these locations to the adjacent nasal, aural, ocular, or respiratory mucous membranes. Rarely it extends to the esophagus and even invades the stomach. Especially in children, the vaginal mucous membrane may be involved. Intact skin is not affected, but when abraded, as by a blister, eczema, etc., it may become the seat of infection, and likewise the surfaces of wounds may be involved.

The leading clinical symptoms are sore throat, fever, and some general malaise. The related lymph-glands are swollen. With involvement of the larynx there is a croupy cough and hoarse voice, and later signs of obstruction. The principal symptoms of systemic poisoning are progressive heart failure, diminished amount of urine which contains albumin, and vomiting. Postdiphtheritic paralyses appear later. Diphtheria is world-wide in its distribution, occurring in the larger cities endemically and in epidemics. In smaller towns and rural districts it occurs in epidemics, following the introduction of the infectious agent from without. The disease is moderately contagious, being transferred through the air for a short distance from the patient by means of moist infected particles or globules thrown out in coughing, crying, etc. The infection may also be transferred by an intermediate carrier, such as soiled clothing, bedding, playthings, eating utensils, etc. A third person may carry the infection upon the skin or clothing or in the hair. Especially dangerous,

[1] Memoirs on Diphtheria, New Sydenham Society, 1859.

as disseminators of infection, are convalescent patients and those suffering from mild forms of diphtheritic infection in the throat and chronic forms in the nose. Virulent bacilli may persist in the throats and nasal cavities of persons who have apparently recovered, for weeks, and rarely even for months, and such persons may be active agents in spreading the disease. Pet animals may carry the infectious material from one person to others, but it is doubtful whether domestic animals are naturally infected with the bacillus. Epidemics have been traced to infected milk. In these instances the milk is contaminated by secretions from cases of diphtheria, either directly or indirectly. Milk furnishes a suitable medium for the multiplication of the bacilli, which, however, bring about no changes in the milk that excite suspicion. An individual predisposition is essential for the development of diphtheria. The virulent bacilli are sometimes carried in perfectly healthy throats without harm. Young infants are rarely attacked. The largest proportion of cases occur between the third and fifteenth years. It is quite common in adults. A temporary immunity follows an attack of the disease, but it is soon lost, and sometimes appears to be followed by increased susceptibility to infection. Relapses and recurrences may occur. Among local predisposing conditions may be mentioned enlarged tonsils, adenoids, catarrhal conditions, either from measles or other causes. The disease is least prevalent in the summer, but occurs throughout the year.

The local diphtheritic process consists in the formation of a pseudomembrane, made up of necrotic epithelium, leukocytes, and fibrin, and always containing a variety of bacteria, among which the diphtheria bacillus is constantly found. The false membrane is occasionally absent. It may be as limited in extent as that of a follicular tonsillitis, or may extend over the greater part of the upper respiratory mucous membranes. The primary seat is most often upon the tonsils, but it may be in the nasal cavities, larynx, etc. The local effects of the diphtheria bacilli are principally accomplished by toxins which they elaborate. The general effects are due to the action of poisons which are formed locally, then absorbed and carried by the circulation to distant organs. Diphtheria, like tetanus, is essentially a local infection with a general toxemia. A few bacilli only are distributed throughout the body. The poisons formed by the diphtheria bacillus, according to Ehrlich, are of two varieties—the toxins,[1] which cause acute death, and toxones, which are responsible for the late manifestations of paralysis. Bolton[2] ascribes the fatty degeneration and cloudy swelling observed in various organs, especially the heart, and acute degeneration of the cells of the lower nerve centers to the toxins. The toxones, he believes, are responsible for the degenerations in the peripheral nerves which occur after the acute stage has passed. In this latter stage fatty degeneration of

[1] In this discussion of diphtheria the term "toxines" is used to designate the mixed poisons formed by the bacilli, and "toxins" to indicate a particular form of poison.

[2] Primary Heart Failure as the Immediate Cause of Death in Acute Diphtheritic Toxemia, Lancet, 1905, clxviii, 278.

the heart and degeneration of the nerve-cells are less liable to be prominent features, but interstitial changes may be found in the heart. The swelling and degeneration in the cervical lymph-glands is ascribed to the action of toxins, carried to them by lymph-vessels. Variations in the virulence of diphtheria bacilli occur, so that certain epidemics are more severe than others. Highly virulent bacilli and great susceptibility combine in producing the picture described as malignant diphtheria. Septic and gangrenous cases are those in which there occurs a secondary infection with pyogenic cocci, especially streptococci. The combined action of bacilli and cocci is supposed to enhance the virulence of each. Bronchopneumonia is common in fatal cases, and is usually due to a secondary infection by streptococci or pneumococci, but apparently may be due to diphtheria bacilli alone.

The mortality is highest in young children and decreases with increase in age. A large proportion of the deaths follow laryngeal obstruction, with which bronchopneumonia is often associated. Death occurs in many cases from heart failure due to the toxemia. Cases in which a mixed infection has occurred are most dangerous and least influenced by treatment. The mortality is favorably influenced in a truly remarkable degree by treatment with antidiphtheritic serum

TREATMENT

Knowing that the pathogenic action of the diphtheria bacillus depends upon toxines which it forms, and having a specific antidote for these poisons, our principal concern is to neutralize the toxines with the antitoxin at the earliest possible moment, and before extensive, irreparable damage has occurred. In addition to this, mechanical obstruction of the larynx must often be relieved by operative measures, and the effects of secondary infections must be counteracted as much as possible.

Being in possession of exact information as to the cause of diphtheria, its location in the body, and the possible channels by which it may escape from the infected individual, efforts to prevent the spread of the disease can be undertaken with intelligence and with every assurance of success. Every sore throat in the time of an epidemic, and every angina with any pseudomembranous formation at any time, should be isolated as if it were diphtheria until bacteriologic examinations have shown it not to be diphtheria. Nasal discharges in children should always be regarded with suspicion and investigated by bacteriologic methods. Cases of diphtheria should be perfectly isolated, all communication between them and the well being interrupted. The nurse must also be isolated with the patient. In a private house satisfactory quarantine can be carried out more readily than in the case of measles and scarlet fever. In order that this shall be successful great care and much intelligent watchfulness on the part of the nurse and family is requisite. Unless a part of the home, preferably one floor, can be set apart for the patient and attendant, it is better to remove the patient to a proper hospital if one is available. During the course of the disease all discharges

from the patient's nose, throat, and mouth should be disinfected by immediate deposition in an antiseptic solution, or by burning cloths upon which they are collected. Soiled bedding and clothing should be disinfected by boiling in water. When the patient is ready for relief from quarantine, the entire body, always including the hair, must be thoroughly bathed in soap and warm water, followed by a general antiseptic bath, which must also include the hair. The attendant must receive similar treatment. The room and its contents must be thoroughly disinfected after removal of the patient. In case of death the body must be wrapped in a double layer of sheets saturated with a strong antiseptic solution and placed in a tight coffin, which must not be opened. The funeral must be strictly private.

The duration of quarantine is to be determined by bacteriologic examinations of the throat and nasal cavities. Before the patient is released, two negative cultures on successive days should be obtained. The persistence of the diphtheria bacilli varies greatly; sometimes they disappear in a few days, and again may be present after several weeks. McCollom[1] finds that the average period of isolation is shortened by releasing patients only when cultures have shown no diphtheria bacilli present, instead of keeping them for the arbitrary period usually considered essential for safety. In hospital cases Graham-Smith[2] found that the bacilli persisted twenty-eight days on the average, in some cases even eighty-seven days. The attending physician must take every precaution to avoid carrying infectious material from the patient to other persons. These are similar to those to be observed in cases of scarlet fever. The special precautions to be taken in the hospital care of diphtheria patients are similar to those recommended in scarlet fever and will be discussed under that subject. The children in a family in which diphtheria is present ought not be allowed to associate with other children; and visitors should be excluded from the infected house. The family should not frequent public gatherings nor the children attend school. It is desirable that the throat of the nurse be examined by means of cultures, and the absence of diphtheria bacilli demonstrated before she goes from diphtheria cases to others. The danger of healthy persons as carriers of diphtheria because of the bacilli in their throats has perhaps been exaggerated. McCollom examined the throats of 60 nurses on duty in the diphtheria ward of the South Department of Boston City Hospital, and in no instance was the bacillus of diphtheria found in cultures. He also examined bacteriologically 150 individuals in which no throat symptoms were present, and in no instance found an organism which on careful examination could be mistaken for the diphtheria bacillus.

Beside these general measures directed toward preventing the dissemination of the infection from persons suffering with the disease, certain measures may be employed which look toward the prevention

[1] The Experience of Nine Years in the Treatment of Diphtheria with Antitoxin, Boston Med. and Surg. Jour., 1905, clii, 621.

[2] The Measures Taken to Check the Diphtheria Outbreak of 1901 at Colchester, Journal of Hygiene, 1902, ii, 170.

of the disease in exposed persons. The use of cleansing and mildly antiseptic gargles and mouth-washes by attendants help to keep the parts in a healthy condition, and thus local conditions are avoided which predispose to the establishment of an infection. Bacilli which lodge upon the mucous surfaces may perhaps be thus dislodged or destroyed. The predisposition to infection by diphtheria bacilli may be overcome by prophylactic injections of diphtheria antitoxin. The protection afforded by the antitoxin is not absolute, but in most instances it protects against infection for a short time. Prophylactic injections are to be recommended for nurses who care for diphtheria patients, but since they are under observation and the disease can be recognized and treated at the start, this is not obligatory. The prophylactic use of antidiphtheria serum is most useful in dealing with children under ten or twelve years of age. For such children the immunizing dose is 500 to 1000 units. Protecting injections are to be given to all the children of a family in which a case of diphtheria occurs; if the people are poor and the children cannot be carefully watched, this is more imperative. The systematic immunization of every child admitted to children's hospitals is being carried out in many places with very satisfactory results. At the Boston Children's Hospital[1] every patient is given an immunizing dose of 500 units, which is repeated every twenty-one days. In 1905 this had been done 9696 times without any harmful results, and one case only of diphtheria had developed, and that in a boy who had escaped his second dose of serum, at the end of twenty-one days. In the Infants' Hospital of Boston, in which epidemics of diphtheria formerly occurred, for over five years each of the 1184 babies admitted received an immunizing dose of 500 units. Most of the babies were under one year old. During this time only one case of diphtheria occurred, and that in a child who received only 300 units of antitoxin. All children affected with measles and scarlet fever should be given an immunizing dose of 500 units of antitoxin when admitted to a hospital. This is especially important in measles, because of the great susceptibility of measles patients to infection by diphtheria bacilli. This prophylactic measure has been tested and found valuable by McCollom,[2] Ibrahim,[3] Northrup,[4] and others.

The patient with diphtheria should be put to bed in a light, well-ventilated room with an even temperature. The atmosphere should not be dry. Liquid nourishment, principally milk, is to be given at regular intervals, and water is to be freely supplied. The skin is to be kept active by daily baths. It is important to keep the patient in bed until danger of heart complications has passed. In the treatment of the individual case of diphtheria we are able to employ a remedy which is absolutely specific, and which will probably cure every case of pure diphtheria, provided it is used early enough. In concluding his paper before the Associations of American Physicians in 1895 Professor William

[1] Boston Medical Library Meeting, Rotch, Jour. Amer. Med. Assoc., 1905, xliv, 1141.
[2] Loc. cit.
[3] Ueber Schutzimpfungen mit Diphtherieheilserum, Deut. med. Woch., 1905, xxxi, 412.
[4] Medical News, 1897, lxxi, 817.

H. Welch said: "Our study of the results of the treatment of over 7000 cases of diphtheria with antitoxin demonstrates beyond all reasonable doubt that antidiphtheritic serum is a specific curative agent for diphtheria, surpassing in its efficacy all other known methods of treatment for this disease. It is the duty of the physician to use it." Subsequent employment of the serum throughout the world has shown that the conclusions he formed thus early were correct, and clinicians everywhere have found that it accomplishes even more than could be hoped for it when it was first introduced. Diphtheria antitoxin was not an accidental discovery, but was the final result of years of laboratory work and animal experimentation, carried out by a large number of investigators. From the discovery of the diphtheria bacillus by Klebs and Löffler until the perfection of the diphtheria antitoxin by Behring and Ehrlich, Roux, and others, numerous intermediate steps can be traced.

The principles upon which the action of diphtheria antitoxin rests may be briefly stated. The diphtheria bacillus in its growth elaborates poisons or toxines. The toxines, according to Ehrlich, are not a simple substance, but consist of toxins which cause acute death and toxones which are responsible for the late paralyses. In the natural course of the disease the toxines in the circulation stimulate certain cells of the body to the production of substances which chemically neutralize them—*i. e.*, antitoxins. The production of antitoxin is not only sufficient to accomplish the neutralization of the toxines, but an excess of antitoxin is set free in the blood of the convalescent patient. The blood-serum from such a patient, if injected into a freshly infected individual, possesses curative value by virtue of the antitoxin which it contains, and which unites with and neutralizes the toxines being formed by the infecting bacilli. It was learned experimentally that broth in which diphtheria bacilli have grown contains toxines in solution. If such a solution of toxines, freed of living bacilli, is injected into animals, it leads to the production of antitoxin. It was found that if horses, which are quite resistant to diphtheria toxines, were injected with non-fatal doses of these poisons a local reaction with elevation of temperature followed. By injecting, at intervals of a few days, gradually increasing doses of toxines, the horse becomes tolerant of larger and larger doses, until, finally, enormous quantities of toxines are borne with little ill effect. As the quantity of injected toxines is increased there is also an increase in the antitoxic content of the blood, and in a suitable horse this finally becomes very great. The blood of such an immunized horse is withdrawn under aseptic precautions, and the serum allowed to separate from the clot. Serum thus obtained is the antidiphtheria serum used in treating diphtheria patients. A small amount of antiseptic is usually added to the serum to insure its preservation. The amount of antitoxin which such serum contains is expressed in "units." The following definitions of a unit are quoted from Rosenau.[1] "The unit may be defined as the neutralizing power possessed by an arbitrary

[1] The Immunity Unit for Standardizing Diphtheria Antitoxin, Bull. No. 21, Hyg. Lab. U. S. Public Health and Marine Hospital Service, Wash.

quantity of diphtheria antitoxic serum kept under special conditions to prevent deterioration in an authorized laboratory." "From a theoretical view-point, the unit may be defined as that quantity of diphtheria antitoxic serum which will just neutralize 200 minimal lethal doses for a medium-sized guinea-pig of a pure poison."

The standard antidiphtheritic serum for the United States is prepared in the Hygienic Laboratory, United States Public Health and Marine-Hospital Service. This standard serum is distributed to licensed manufacturers and others working in this line. By this means a standard strength of the antidiphtheritic serum sold in the United States is insured. When the value of a given serum is to be determined, the procedure is as follows: The standard test serum is diluted so that 1 cc. contains one immunity unit. This quantity of serum is mixed with increasing amounts of the diphtheria-poison, and the mixture injected into a series of guinea-pigs in order to determine the least amount which will kill the animal in four days. The test dose of poison thus determined is then mixed with such a quantity of the serum to be tested as is supposed to contain one immunity unit and the mixture injected into a guinea-pig. If the animal dies within four days the serum does not contain the strength it had been supposed to. If the animal dies within the fifth or sixth day, then the serum is exactly on the limits. By a series of tests with mixtures containing varying amounts of serum the exact number of units in the serum is determined.

The liquid antidiphtheritic serum, which is the one usually employed, is a yellow, clear fluid having at most a very slight precipitate, and having a slight odor of the preservative. It is put up in bottles containing from 500 to 10,000 units. Antidiphtheritic serum prepared by precipitation after the method of Gibson has recently come into wide use. It has the advantage over the whole serum of allowing the injection of a given amount of antitoxin in a reduced bulk. Serums containing less than 250 to 300 units to each cubic centimeter are of doubtful therapeutic value. By using high-value serums the injection of large quantities is avoided. The average dose of antidiphtheritic serum for purposes of immunization is 500 units; for therapeutic purposes, 3000 units.

It is hardly necessary at this time to advance arguments to show the value of diphtheria antitoxin in diphtheria. A few figures, given by McCollom and based upon his experience in Boston, where he has enjoyed exceptional opportunities for study of the subject, will serve as an example of the experience of observers everywhere. In the Boston City Hospital before antitoxin was used—1888 to 1894—the death-rate in diphtheria was 43.20 per cent. From 1895 to 1904, when antitoxin was given every patient, the death-rate was 11.84 per cent. In 1896 the mortality was 14.00 per cent., and since then it has gradually diminished, until in 1904 it was 9.50 per cent. The difference is evidently due to larger doses of antitoxin and general earlier admission of patients to the hospital. In intubation cases, before antitoxin was used, the mortality was 78 to 86 per cent. From 1895 to 1904, 64 to 26

per cent. died. Since 1899, 33 to 26 per cent. died. The lowered mortality can only be explained by the introduction of antitoxin in the treatment. The figures just quoted are no more remarkable than those reported by all clinicians who have used antitoxin extensively. Observations have now extended over so many years, and have embraced such a large number of cases, that the favorable showing cannot be explained by the character of epidemics. Even more convincing than statistics is the enthusiastic testimony of practitioners who observed diphtheria clinically before and since antitoxin was introduced.

The serum is to be injected, with a carefully sterilized syringe, into the subcutaneous tissues. In cases in which very prompt effects are sought intramuscular injections are recommended, since absorption is more prompt from muscular tissues. In very critical cases the serum may be injected directly into the veins, as has been advised and practised by some authors. The skin at the point of injection is to be sterilized as for a surgical operation, and the puncture subsequent to the injection should be protected by a pledget of sterile cotton held in place by collodion. The best locations for the injections are the outer side of the thigh, the posterior axillary line of the chest, or the abdomen.

It must be remembered that foreign sera are more or less toxic when injected into animals. This is true of horse serum when injected into man. Following the injection of antidiphtheritic serum in man, after an interval of a few minutes to three weeks or more, there occurs a "serum reaction" in from 14 to 50 per cent. of the cases. The frequency and severity of the reaction are generally in direct proportion to the quantity of serum injected. The toxic property is also contained in normal horse serum, and there is no evidence that the antitoxin is toxic in itself. The usual symptoms occurring in the "serum reaction" are fever, edema, swelling of lymph-glands, leukopenia, pains in the joints, and skin eruptions, especially urticaria and erythemas. These disturbances are usually transient and subside in a few days. In rare cases there has been observed extreme collapse, and in infants convulsions. The severe reactions are most apt to occur in persons who have been previously injected with serum or who give a history of asthma.

Gillette[1] has collected from the literature and personal communications 28 cases of severe general reaction, 15 of which were fatal; 18 of his cases occurred in persons with a distinct history of asthma, 9 of whom died. Such accidents may be largely eliminated if care is taken to avoid the use of serum in persons who give a history of asthma. If it is urgently indicated in such persons, a very small preliminary dose of serum should be given to test the susceptibility of the patient before giving larger doses. The same precautions are to be taken in the administration of serum to persons who have been injected with serum at any time previously, since the first injection may have rendered them hypersensitive to it. The possibility of severe reactions must be practically ignored in the treatment of diphtheria, since antitoxin often

[1] Therap. Gaz., 1909, xxxiii, 159.

saves in a city hospital in a single month more lives than the serum can be said to have sacrificed throughout the world during the sixteen years since it came into general use.[1] Abscesses following injections of antidiphtheritic serum are due to imperfect technic or impure serum.

Antitoxin should be given at the earliest possible moment. The value of early administration is well shown by McCollom's experiences. In the South Department of the Boston City Hospital 190 cases of diphtheria among doctors, nurses, and employees were treated with antitoxin without a death. Antitoxin was given to all in large doses at the onset. In many cases this could be done while there was only congestion of the mucous membrane. By this means the formation of a membrane was often prevented. In all cases the diagnosis was confirmed bacteriologically. The importance of early administration of antitoxin is shown in the following tabulation by Cohn:[2]

Deaths According to the Day of the Disease on which Antitoxin was Given:

First day, 78 patients	1.3	per cent.	died.
Second day, 361 patients	11.1	" "	"
Third day, 284 patients	10.5	" "	"
Fourth day, 101 patients	24.7	" "	"
Later and unknown, 176 patients	22.7	" "	"

This table shows that few of the patients treated on the first day die, that the number of deaths rapidly increases as the interval before treatment is lengthened, and that the mortality is greatest when antitoxin has not been given until four or more days after the onset of the disease. Similar statistics could be quoted from numerous sources. Extensive study has shown that most cases which would be recognized clinically as diphtheria prove to be so upon bacteriologic examination. All such cases and all suspicious cases should receive the antitoxin as soon as possible after coming under observation, not waiting for the results of examination by cultures. As there is no means of judging the amount of toxines already in the system, the initial dose should be a full one,—3000 to 4000 units,—and it should be repeated every four to six hours until favorable effects are apparent. For a child less than one year old, 1500 to 2000 units is a suitable dose in an ordinary case. When the toxines have been neutralized, this is evidenced by a decline in the fever, by a marked improvement in the general feeling of the patient, and by a reduction in the local discomfort. The laryngeal stenotic phenomena cease to increase and soon decrease. Locally, the membrane ceases to extend, its color changes from grayish-yellow or grayish-green to a lighter yellow, and soon becomes sharply outlined upon the red underlying surface, and begins to loosen and peel off at the borders. In extreme cases 10,000 to 12,000 units should be given and repeated in four to six hours or even less. In these cases little good can be expected from small doses. In cases with laryngeal stenotic symptoms relatively large doses are indicated. The initial dose in such a case should never

[1] A general discussion of the "Serum Disease," with a review of the literature, will be found by Weaver, in the Archives of Internal Medicine, June, 1909.

[2] Erfahrungen über Serumbehandlung der Diphtherie, Mitteilungen aus den Grenzgebieten der Medizin u. Chirurgie, 1904, xiii, 614.

be less than 8000 or 10,000 units, and it should be repeated at short intervals until relief is obtained. McCollom reports the administration of 90,000 units during five days in a bad case, which terminated in recovery. In the Cook County Hospital of Chicago we have repeatedly administered from 50,000 to 100,000 units with most gratifying results in cases which came under treatment several days after the onset of the infection, and in which extensive surfaces were involved and symptoms of extreme intoxication were present. It cannot be too strongly emphasized that enough antitoxin must be given to neutralize the poisons in the patient's body, and that this must be accomplished as rapidly as possible. With this end in view the injections must be repeated at relatively short intervals, and the doses increased, if necessary, until pronounced improvement in the condition of the patient shows the desired object to have been attained.

Under the treatment of diphtheria with abundant quantities of antitoxin the heart complications are not so common, and paralyses do not occur so frequently. In the prevention of cardiac and renal complications only the earliest use of antitoxin can be expected to yield the best results, since extensive degenerations may occur within two days. As was to be expected, paralyses are prevented by the administration of large quantities of antitoxin. Ehrlich has shown that the toxins in the diphtheria poison which cause the acute changes are first neutralized by antitoxin, and that the toxones, which are responsible for the late paralyses, are only neutralized after the toxins have been satisfied. Hence, a surplus of antitoxin is required certainly to neutralize all the products of the infecting bacilli. The antitoxin acts only by neutralizing the poisons in the body. It has no power to restore injured and degenerated cells to their former health. Therefore, late administration of the serum must not be expected to cure those cases in which irreparable damage has been done to vital structures before the antitoxin was given.

Local treatment of the nose and throat has perhaps been too much neglected since the introduction of antitoxin. It has been such a relief to be rid of the necessity for the active local treatment which was formerly carried out under great protest of patients, and often by sheer force in children, that there has been a tendency to do little locally. It must not be forgotten that the diphtheria antitoxin acts specifically against the products of diphtheria bacilli alone, and that the effects of secondary infections must be met by suitable measures. It is advisable to keep the mucous membranes of the nasal, pharyngeal, and buccal cavities as clean as possible by the use of mild antiseptic washes. Strong antiseptic and irritating solutions are to be avoided. The disappearance of the diphtheria bacilli appears to be more facilitated by washes of physiologic saline solution than by strong antiseptics.

Symptomatic Treatment

For the pain and discomfort in the throat, small pieces of ice held in the mouth are often grateful to the patient. A good deal of relief is sometimes afforded by an ice-bag worn about the neck.

Complications

In cases with laryngeal involvement the early use of antidiphtheritic serum in sufficient doses will frequently obviate the need of operative relief of obstruction. If symptoms of laryngeal obstruction are urgent they should be relieved by intubation or tracheotomy without delay. If there is much swelling of the cervical lymph-glands, an ice-bag may be applied. If an abscess forms in the glands, it is to be incised as soon as pus is present. For the general toxemic disturbances, manifested by rapid and irregular heart, occasionally by slow heart, and sometimes by vomiting, alcohol is to be given freely and frequently repeated. Strychnin is of value, but not equally with alcohol. Digitalis is apt to be not well borne. With these measures must be combined absolute rest in bed in the recumbent position. The patient should not be allowed to get up until the signs of heart weakness have disappeared. Bronchopneumonia and otitis are to be managed on general principles. During convalescence the anemia, which is usually present in greater or less degree, is to be overcome by suitable tonics, especially iron, and plenty of nourishing food.

Postdiphtheritic paralyses, coming on in the second or third week, are due to a multiple neuritis produced by the action of the toxones of the poison. They are to be treated by quiet in bed, especially if the heart is irregular. If the heart is dangerously affected, the patient must be kept quiet with morphin, which may he combined with strychnin. In the chronic stage electricity, massage, strychnin, general tonics, and cod-liver oil are to be used. Whether antidiphtheritic serum has any influence over postdiphtheritic paralysis if administered after the paralysis has developed is a matter of dispute. General opinion is that it has little if any effect at this time.

INTUBATION AND TRACHEOTOMY IN DIPHTHERIA

By John H. Jopson, M. D.

In every case of diphtheria with symptoms of laryngeal involvement the possible necessity of operative intervention must be borne in mind. Even at the present day the lives of many children are undoubtedly sacrificed by a tardy or hesitating attitude on the part of the medical attendant in the face of this complication. By the free use of antitoxin the percentage of cases of laryngeal diphtheria requiring operation has been greatly reduced, and laryngeal involvement of any grade should be a signal to push the administration of antitoxin. Such symptoms are the suppression of the voice, the laryngeal or "croupy" cough, and noisy or stridulous breathing. Slight stenosis will probably accompany these symptoms. Stenosis is manifested by restlessness, inability to sleep, and a recession on inspiration of the supraclavicular and suprasternal tissues, and, what is important and easily discerned, a retraction of the epigastrium and lower ribs on either side with each inspiratory effort. As stenosis increases and oxygenation is still further interfered with, these symptoms increase in degree, and the suffering of the patient becomes greater. Restlessness increases, the child tries to sit up, cyanosis and, later, pallor, especially about the lips, develop; the pulse becomes rapid, the breathing stridulous; each inspiration is attended by great effort, all the accessory muscles of respiration being brought into play, and the epigastrium and base of the chest anteriorly are drawn far in with each inspiratory effort. The picture is one of great distress. If not relieved, the child often becomes comatose, and death finally intervenes. In other cases fatal obstruction comes on, not gradually but suddenly during periods of mild or moderate stenosis, and before relief can be obtained the child perishes.

When laryngeal symptoms appear, steam inhalations are beneficial, and the child may be placed in a croup-tent and steam led beneath it from a croup kettle, or by slaking lime, or a steam atomizer may be used. Emetics are sometimes used to aid in loosening and dislodging membrane, but in our experience are of little benefit in true diphtheritic croup. If the stenosis is mild in degree, it may be held in abeyance by these measures until the antitoxin has acted, and the patient escape operation. If, in spite of this treatment, the stenosis increases and restlessness and cyanosis are noted, with marked recession of the base of the chest and epigastrium, operation should be performed. When the child is markedly obstructed when first seen, one should prepare for operation while using the measures already described, and interfere

unless quick relief is afforded. In cases of mild obstruction, long-continued stenosis may exhaust the child and favor the development of bronchopneumonia, while a sudden exacerbation of symptoms may prove fatal. In cases of doubt, intubation should be performed, as intubation, of itself, is an operation of slight risk. On the other hand, no case of diphtheritic laryngitis, however desperate or apparently hopeless, should be abandoned without an attempt to relieve obstruction by operation.

For the relief of laryngeal obstruction due to diphtheria, two operations are practised—intubation and tracheotomy. Intubation has largely superseded the older operation in the treatment of this condition, and will be described first.

INTUBATION

The operation of intubation as practised at the present time for the relief of laryngeal obstruction in diphtheria was devised and perfected by the late Joseph O'Dwyer of New York. Attempts to introduce an operation which would supplant tracheotomy for this disease had previously been made, the most noteworthy being that of Bouchut,

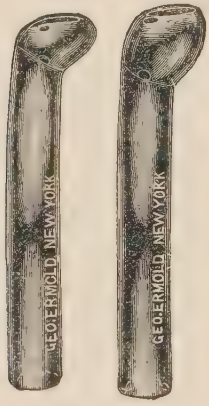


Fig. 6.—Ordinary intubation tube and tube with built-up head for granulations.

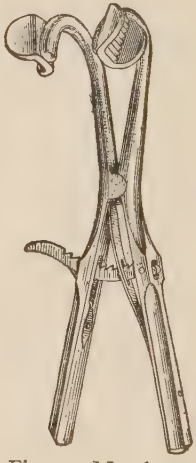


Fig. 7.—Mouth-gag.

in 1858, but it was reserved for the genius of O'Dwyer, working from 1880 to the time of his death, to devise and perfect, single handed, the operation which has become the procedure of choice in laryngeal diphtheria. It consists in the introduction into the larynx of a specially devised tube, which is allowed to remain *in situ* until the diphtheritic process has sufficiently subsided to permit respiration to be carried on unobstructed. Special instruments for its introduction and removal are also provided. In the ordinary intubation set there are seven tubes, ranging in size from that suitable for an infant up to a tube large enough for a child of twelve years. The operation is seldom

required in diphtheria after this age. Special tubes of larger size are contained in sets for use in adults. A metallic scale is provided, marked by divisions corresponding to the age to which each tube is applicable. This scale is arbitrary, and judgment must be used by selecting the tube according to the size as well as the age of the patient. The tube is of polished hard rubber with a metal lining, and has an expanded upper end or head, cut away in front to permit the epiglottis to fold over it when swallowing. It rests upon the false vocal cords, and is narrowed from

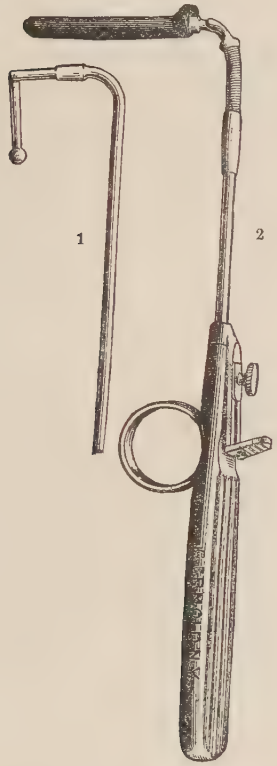


Fig. 8.—1, Obturator; 2, introducer with tube.

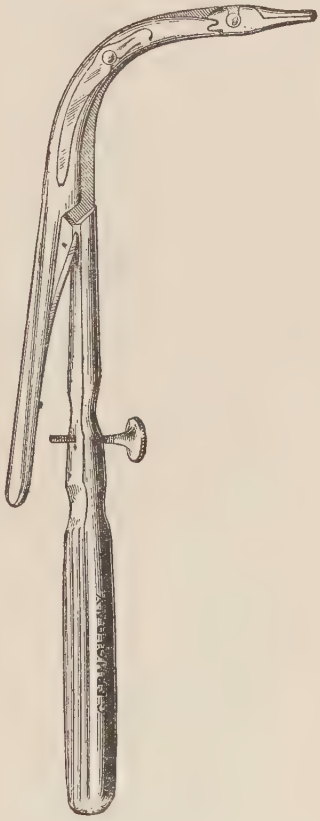


Fig. 9.—Extractor.

side to side below the head, to prevent injurious pressure at this point. A retaining swell is located at the middle of the tube, which lies below the vocal cords when it is in place and prevents expulsion on coughing. The lower end of the tube is slightly expanded, with rounded edges to prevent ulceration of the trachea. There is a small perforation in the head of the tube, to the left of the anterior median line, through which a silk thread is passed before introduction. Each tube is fitted with an obturator, jointed at a point corresponding to the middle of the tube to permit removal after the tube is in place, and rounded at its lower

extremity, completely occluding the tube during introduction. It is curved to a right angle above the tube, and fits into the introducer, which is provided with a sliding mechanism and spring, by which the tube is pushed off the obturator after introduction. The extractor is a beaked instrument with a curve corresponding to the introducer and obturator, and with jaws serrated on the outside and separated by pressure on the handle; this is opened after introduction into the mouth of the tube, grasping it firmly in its lumen. A mouth-gag accompanies the set, to which may be conveniently added a pair of scissors and some fine braided silk for rethreading the tubes. This description applies to the O'Dwyer set and the O'Dwyer tubes, which may safely be said to be the only satisfactory models, nothing having been introduced which in the judgment of intubationists of experience can take

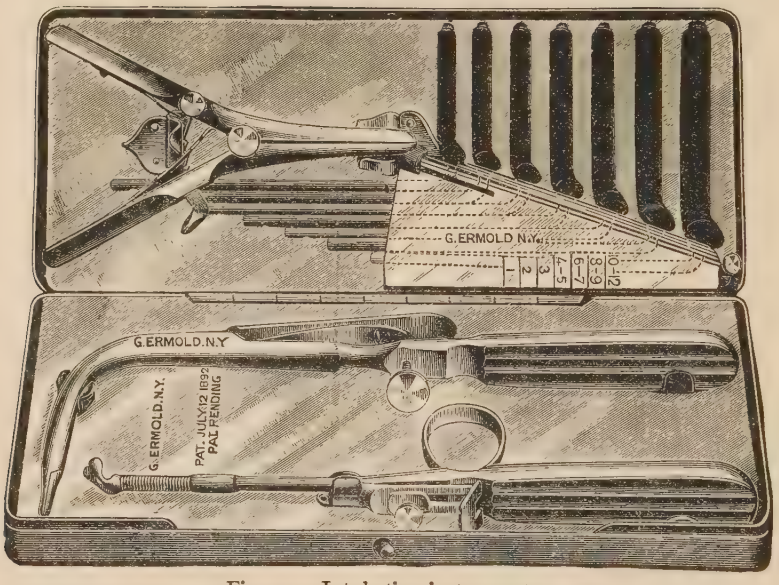


Fig. 10.—Intubation instruments.

their place. The metal tubes of the original O'Dwyer pattern have been practically supplanted by the lighter rubber tubes, which have the additional advantage of not becoming incrusted by calcareous deposits, and being less liable to cause ulceration. The Bayeux tubes are of shorter pattern and have been extensively used in Europe, but have gained no popularity in this country. Most of the so-called improvements, or improved sets, have been really retrogressions in type, either ludicrous or palpably dangerous. For a history of the O'Dwyer operation the reader is referred to O'Dwyer's original papers, and to the article on Diphtheria by W. P. Northrup in the American edition of Nothnagel's Encyclopædia of Practical Medicine.

For the performance of the operation two assistants are desirable, although in an emergency one is sufficient. The usual position is for

Fig. 11.—Intubation with the patient in the sitting position (Northrup).

Fig. 12.—Intubation with the patient in the dorsal position (Northrup).

the nurse to hold the child in the sitting posture, first wrapping it in a a blanket, including its arms. The nurse sits upright, facing the operator, the child upon her lap, leaning against her chest. Its elbows are confined to its side by the grasp of either hand of the nurse, its legs being grasped between her knees. The gag is inserted on the left side of the child's mouth, and the handle pressed against the cheek by the left hand of the assistant, who stands behind the nurse. His right hand is spread out upon and steadies the right side of the child's head, which is thus held firmly in a perfectly upright position. The operator, in the meanwhile, sits or stands immediately in front of the nurse. The succeeding steps are carried out quickly, but with precision; undue precipitancy will be apt to result in mortifying failure. The index-finger of the operator's left hand, which is protected by a metallic shield or, which we prefer, by a strip of adhesive plaster, from the base to below the first joint, is inserted into the child's mouth and carried back along the tongue to the opening in the larynx, which is located at once. No blindfold following of directions as to the proper introduction of the tube will avail unless the opening in the larynx is definitely located by the finger. The epiglottis is folded forward toward the base of the tongue by pressure with the finger, and the larynx steadied by a slight downward pressure. The handle of the instrument carried in the right hand is held parallel to the child's chest, and the tube, previously warmed by immersion in water, introduced horizontally in the median line, close to the tongue, until its tip reaches the root of the tongue, when the handle is raised in a gradual curve, and the end of the tube carried downward and backward alongside the tip of the forefinger, engaging in the larynx, when it is gently pressed downward and a little forward until its head is in contact with the finger. The trigger of the introducer is now pressed forward by the thumb of the right hand, and the tube is thus partly detached from the obturator. The index-finger is slipped over the tube, and pushes it downward into place as the obturator is withdrawn by a reversal of the introducing movement. If the glottis does not allow the passage of the tube by gentle pressure, no force should be observed, but a smaller tube substituted. It is important that the introducer and the tube should be kept strictly in the median line. No force is allowable, as serious damage may be done to the larynx, false passages perhaps being made, or ulceration may occur later as the result of undue pressure by the tube, and annoying and dangerous complications may follow. The gag is then removed, the silk thread remaining attached to the tube being hooked over the ear or secured to the cheek by a piece of adhesive plaster. The child is then allowed to lie down and rest in the nurse's arms, its hands being still confined to prevent it catching at the thread and removing the tube.

Many operators now prefer the supine position, less assistance being necessary. It should always be preferred when the patient's heart action is rapid and feeble. For the performance of the operation in the supine position, the child is wrapped in a blanket and laid flat upon its back. The assistant, standing or kneeling at the head, inserts the gag

in the usual manner and steadies the head with his hands on either side. The operator stands on the right of the patient and leans over, introducing the tube by the manipulations already described.

The introduction of the tube is usually followed by a violent attack of coughing, attended by the expulsion of mucus and pus, often in large quantities, which have accumulated in the trachea. Portions of membrane or complete casts of the trachea and bronchi may be expelled. The excitation of coughing is a good symptom and the expulsion of the highly infectious contents of the pulmonary tract is very beneficial. If the child is too prostrated for coughing to be excited and for the expulsion of the secretions, a little whisky and water will usually provoke a response in this direction.

If the opening in the larynx has not been well located, and the operator has not succeeded in passing the tube into it, it finds its way into the pharynx. This is usually at once detected by the finger passing down alongside of it when examined. Persistence of respiratory obstruction and absence of coughing will also indicate failure. In such cases the operation must be repeated. It is less exhausting to the patient to make several brief attempts than to persist in a single prolonged one, as respiration is absolutely checked during the passage of the tube. If the operation has been successfully completed, respiration will become quiet and slow, cyanosis disappears, the child will look more comfortable, and if undisturbed quickly passes into slumber. Occasionally an irritating cough may persist for some minutes. The recession at the base of the chest and at the suprasternal notch disappears. The examining finger feels the head of the tube protruding slightly above the glottis. After respiration has been satisfactorily established and coughing has ceased, the string may be removed. The child is placed in the primary position in which the tube was introduced, the gag is again inserted, the loop of string is severed close to the mouth, and with the finger placed on the head of the tube to keep it in position, the string is removed by traction on the longer end. Some operators prefer to leave the string attached to facilitate extubation. To prevent it from being bitten through it should be sunk between two teeth on the left side of the lower jaw and the end secured to the cheek by a piece of adhesive plaster.

The operation sometimes fails to relieve. This may be due to a mistaken diagnosis, pneumonia being the main factor in causing the dyspnea. Failure is usually due to membrane below the tube, either primarily or displaced downward during intubation. In the first case respiration continues obstructed as before, sometimes a rattling sound being audible during inspiration; in the second case it may become very much worse, or the child ceases to breathe altogether, becoming still more cyanosed, and unless the tube is removed it may succumb at once. Prompt removal of the tube by the string will sometimes be followed by relief or even expulsion of membrane. It may be reintroduced once, and if it still fails to relieve, tracheotomy should be performed. In some cases the introduction of special tubes, as devised

by O'Dwyer for this emergency, may be employed to facilitate expulsion of membrane. These tubes are short and cylindric in shape, of large caliber, have no retaining swell, and are for use only in tiding over an emergency. They are rarely required. This accident is uncommon and usually demands tracheotomy, and for this reason the tracheotomy set should always be carried with the intubation set, although it should be emphazised that it is only rarely required. Membrane may exfoliate in the trachea some time after the tube has been introduced and cause an increase in dyspnea, demanding removal of the tube and possibly a reintroduction, either maneuver often being followed by expulsion of the membrane.

Arrest of respiration may take place during intubation either from exhaustion or, as Crile has demonstrated, by irritation of the terminals of the superior laryngeal nerves with reflex respiratory and cardiac failure. Stimulation, both externally and internally, with artificial respiration are demanded for respiratory and cardiac arrest, which in our experience only occurs in desperately sick children, in whom any procedure is attended by a correspondingly greater risk. Crile recommends lowering of the head, artificial respiration, and slapping of the chest with a cold wet towel. He guards against such effect on the heart by a preliminary hypodermic of atropin.

The most unfortunate postoperative accident following intubation is due to a sudden impaction of membrane which has exfoliated *en masse* below the tube. Violent expulsive efforts in coughing will often expel both tube and membrane. If this does not occur, and unless extubation is rapidly carried out, the patient perishes. Inversion of the child and slapping on the back by the nurse favors expulsion and is justifiable. A gradual accumulation of secretion in the lumen of the tube may cause its gradual occlusion. This seldom happens if sprays are used and a moist atmosphere is properly maintained. Here ample time is given to remove and cleanse it. If, after intubation, there is any reason to suspect the presence of membrane below the tube, the string should be left in place, and, if possible, a physician remain in attendance. With the string in place the nurse can readily remove the tube.

After-treatment.—The patient must be carefully nursed and well watched. The nursing of intubation cases is easier than in tracheotomy cases. The patient should not be left alone. The room should be kept at a temperature of 75° F., and the air kept moist by having a little water heated over a flame. The croup-tent is useful in bad cases where there is much membrane, or where the trachea and lungs are extensively involved; it is not necessary to confine the child in it continuously, as we believe the constant confinement to the close atmosphere is not beneficial. It is better to use it intermittently and in emergency. The use, at frequent intervals, of the steam or hand atomizer, containing a glycerin and soda solution,

℞. Sodii carbonatis ..... gr. viiss
Glycerini ..... f℥j
Aquæ ..... q. s. ad. f℥j.—M.

or in the hand atomizer a 25 per cent. solution of hydrogen peroxid is indicated. These assist in liquefying the secretions and keep the tube free.

The feeding problem is the most troublesome. Most children learn to take food after a day or two. Semisolids are usually more easily swallowed than liquids, which excite coughing by finding their way into the tube and trachea. A choice may be made of junket, cornstarch, soft-boiled egg, bread and milk, custard, and later ice-cream. All food should be given slowly and liquid foods and medicines by spoon or dropper. Young children who use the bottle may be fed by laying them across the nurse's lap, with the head lower than the body (Casselberry). Cracked ice may be given to relieve thirst. As previously remarked, children soon learn to take food without great annoyance. Rarely gavage is necessary. We have used it to advantage when the patient refused to take nourishment. Enemata of water also help to allay thirst.

Treatment directed to the constitutional condition must not be overlooked. Stimulation by strychnin and whisky is of importance. If bronchopneumonia develops, the prognosis becomes much more serious. The above-mentioned drugs and perhaps digitalis will be required, and pushed according to indications. Heart-failure and an extension of the membranous process to the bronchial tubes are the next most frequent causes of death. Extension of membrane to the trachea below the tube may demand secondary tracheotomy. It is indicated by an increasing mechanical dyspnea, the tube itself being free of membrane. If the membrane is loose, there is a rattling sound in respiration, as already described. If extubation and reintubation do not relieve, tracheotomy is indicated.

Extubation.—The time that the tube is required varies in different cases. It has been shortened by the use of antitoxin. Remembering, however, that much of the obstruction is due to infiltration as well as to a deposit of membrane, it is a mistake to remove the tube too soon if it is causing no inconvenience and the child is doing well. While some operators recommend extraction at the end of forty-eight hours to avoid the danger of ulceration from the result of pressure, it is our own practice in the average case to remove it about the fifth day. It will frequently be coughed out before this time, and in the majority of cases reinsertion will not be necessary after spontaneous extubation. Rarely it is swallowed after being coughed out of the larynx; it passes through the intestine without causing trouble. The condition of the throat and the general course of the disease are of aid in fixing the time for extubation. Extubation, while usually considered equally as difficult, or more difficult, than intubation, is, in reality, much less trying in the average case, as the patients are usually in much better condition to stand the operation and are less terrified by it. The preparations are the same as for intubation; the positions of the patient, operator, and assistants are identical. Another tube of the same size should be ready for reintroduction if necessary. After insertion of the gag, the

operator inserts his left index-finger into the mouth and locates accurately the top of the tube. He then passes the extractor with the right hand, the screw of the instrument having been previously set at the proper point to permit of sufficient opening of the jaws to firmly grasp the tube. It is inserted in the same manner as directed for introduction of the tube, raising the handle as the point of the instrument passes over the root of the tongue until it touches the head of the tube. The opening is located by moving the point around until it engages, or by a gentle tapping motion on the top of the tube. When it is felt to be in the opening, it is dropped downward until it is firmly engaged, the jaws of the instrument separated by pressure on the handle, and the tube drawn first upward, then forward and outward, the left index-finger closely approximated to and following it, to prevent it from slipping backward into the larynx or pharynx if released too soon. It is possible to dispense with the extubator, and some operators habitually use manual measures for extubation. In Trumpp's method the chin is elevated with the left hand, while the right is used for a forcible upward stroking movement over the trachea, followed by depression of the chin; the tube is expelled from the mouth or removed with the finger.

After extubation the patient is placed at rest, carefully watched, the surgeon remaining in attendance for an hour. Nothing is administered by the mouth and the child is encouraged to remain quiet. Dyspnea when it returns usually does so gradually, the child becoming restless and excited, with labored breathing, retraction of the base of the chest, etc., symptoms which when persisting for any length of time call for reintubation. When slight, these symptoms are often due to transient edema or spasm following relief of tube pressure, and may later abate. The surgeon should be within call for at least twenty-four hours, and a careful watch of the patient should be kept up for a day or two.

When reintubation is necessary, a secondary attempt may be made to remove the tube after two or three days, which will usually be successful. In obstinate cases several extubations and reintubations are necessary.

Retained Tubes.—In some cases, fortunately infrequent, it is found impossible to get rid of the tube at the usual time, and after several extubations and reintubations it is found that the interval in which the child can breathe without the tube becomes shorter and shorter. In some of these cases there is also a great tendency for the tubes to be coughed out—auto-extubation—quickly followed by return of dyspnea. This subject has received much study, and its pathology and treatment have been in some dispute. O'Dwyer, Rogers, Bokay, Galatti, Ranke, and others have studied it, and widely varied views have been held as to its cause and treatment. It occurs in about 1 per cent. of cases of intubation. Henry W. E. Berg [1] classifies the cases as follows:

[1] Chronic Postdiphtheritic Laryngeal Stenosis as a Cause of Persistent Intubation of the Larynx, Medical Record, 1903, vol. lxiv, 161.

(1) Cases of prolonged stenosis, in which the original conditions which necessitated the intubation persist beyond the usual length of time.

(2) Cases of prolonged stenosis, due to pathologic changes which have arisen during or subsequent to the primary intubation, and are not those of the diphtheritic process which necessitated the primary intubation. Such lesions are due (*a*) to the injurious effect of the intubation tube upon the structures of the glottis, larynx, or trachea; (*b*) to traumatism produced by the operator either during intubation or extubation.

(3) Cases of persistent intubation due to paralysis of the vocal cords: (*a*) temporary paralysis or spasm; (*b*) persistent paralysis.

In some cases the pathologic lesions are the same as those found in the larynx in cases of retained tracheotomy tubes in which the tracheal tube cannot be dispensed with at the usual time, and which are primarily of diphtheritic origin. In other cases the intubation tube is itself responsible for the lesions which in turn render necessary its presence. Traumatism during operation and ill-fitting tubes are the principal causes, according to O'Dwyer. The lesions consist in a hypertrophic form of subglottic laryngitis, pressure ulcers (decubitus) of varying depth, granulations at the base of the epiglottis, cicatricial stricture, and abscess.

It is probable that they are seen more frequently at the present time than before the antitoxin era, from the fact that many cases with severe local lesions which formerly perished now survive.

The treatment consists, first, in avoiding tracheotomy, which aggravates the condition. It may occasionally be required under certain circumstances when auto-extubation is frequent and uncontrollable. Mild cases are usually cured by carefully repeated intubation, avoiding frequent removal of the tube. Opium is useful before extubation to overcome spasm. O'Dwyer's special tubes, with built-up head for granulations around the opening of the larynx, and with the retention swell carried toward the lower end of the tube, for cases of subglottic occlusion, may be used. The tube may first be coated with an astringent solution of alum and gelatin, 5 to 10 per cent. in strength. For severe cases the simple procedure recommended by John Rogers, Jr., has been employed by us with success. It consists in the introduction of as large a hard-rubber tube as can be introduced without damage, its retention for from five to six weeks, and removal and reintroduction if necessary at the end of this time. Some cases of stricture may be thus dilated up to the full caliber of the larynx by this method. In some patients this method fails, the tube being constantly expelled, and Rogers has obtained good results by tracheotomy, followed by the use of special intubation tubes with a plug attached at right angles and protruding from the tracheal fistula. Thyrotomy, with division or excision of the occluding scar tissue, followed by Thiersch grafting, or dilatation by intubation tubes or bougies has been done. In the very severe cases treatment must be prolonged to be of value.

TRACHEOTOMY

Tracheotomy may be required in laryngeal obstruction in diphtheria (1) where intubation instruments are not within reach and the case is an urgent one; (2) when no physician trained in the operation of intubation is at hand; (3) where intubation has been tried and has failed to relieve the obstruction, either because of extreme swelling and edema of the fauces, tonsils, and epiglottis, or owing to the presence of membrane below the tube; (4) as a secondary operation when accumulations below the tube cannot pass through it and are not expelled when the tube is removed. Intubation is, in skilled hands, a speedy, safe, bloodless, and almost painless measure, and neither in its performance nor after-treatment can it be compared with an operation like tracheotomy, which, even in the most skilful hands, is more difficult and trying to the surgeon, terrifying to the patient and parents, and fraught with dangers much greater than those attending intubation. Tracheotomy is demanded, however, in certain cases of laryngeal diphtheria, although a relatively small proportion, and as Trumpp has emphasized, tracheotomy and intubation should not be considered as rival operations, but rather as mutually supplementary, each one with its own indications. Every intubationist should be familiar with the operation of tracheotomy, and tracheotomy instruments should be included in his set when summoned to a case of laryngeal diphtheria. It has happened to most intubationists of experience to be compelled to perform tracheotomy quickly and under trying circumstances. Tracheotomy can be performed in an emergency with few instruments, but this is no excuse for failure to provide one's self with those needful for its proper performance. These include one small scalpel, a pair of scissors, a pair of plain and a pair of toothed dissecting forceps, several pairs of hemostatic forceps, a short and broad grooved director, a sharp tenaculum, a pair of very small retractors (aneurysm needles will answer), and tracheotomy tubes of various caliber. The tracheotomy tube should be of silver or silver-plated, a quarter-circle in shape, of the same diameter throughout, the outer tube unfenestrated and provided with a guide tube, to facilitate introduction into the trachea. For young infants a No. 1 tube may be used, No. 2 up to three years, and the larger sizes in older children. There is no fixed relation between the age of the child and the size of the tube, however, and the tube should be selected which fits easily in the trachea. A sharp-pointed tenotome for opening the trachea, and tracheal dilators and forceps are useful. Ligatures, needles, and sutures complete the list. Gauze sponges and solutions are to be provided.

The usual antiseptic measures for preparation of the field of operation and the hands of the operator and assistants should be observed, except in times of great emergency. When the operation is a secondary one to intubation, it is often convenient to leave the intubation tube in the larynx until the trachea is opened, as it makes a good guide upon which to cut and facilitates the operation by allowing respiration to continue during its performance. The child is placed flat upon its

back, the arms controlled by a nurse, the chest and surroundings covered by a sterile sheet. The shoulders are supported by a sand-bag, small pillow, or similar support, the head and neck being fully extended, thus drawing the trachea upward and forward near the surface of the neck. The child's head is firmly held by an assistant, who stands or kneels at the head of the table, taking care that the head does not move to either side, "keeping the chin most rigidly in a line with the sternal notch" (Treves). The operator stands at the right of the table or at the head. An assistant stands on the left-hand side, hands instruments, holds the retractors and sponges. No general anesthetic is advisable. A few whiffs of chloroform may be harmless in some cases, but any anesthetic usually increases the obstruction. The operation should be performed carefully and not too hastily, unless respiration ceases altogether. The outlines of the thyroid and cricoid cartilages are first carefully defined. The incision starts just above the upper border of the cricoid cartilage in the median line, and is carried downward from 2 to 2½ inches through the skin and superficial fascia. The anterior jugular veins are displaced or clamped, as are any communicating branches which may appear in the wound. The anterior layer of the cervical fascia is divided to the full length of the skin incision, and the interval between the sternohyoid and sternothyroid muscles separated by blunt dissection. These are retracted by an assistant and the layer of fascia beneath them is divided. The trachea, with the isthmus of the thyroid gland lying upon it, is exposed. The median line of the neck is still the line of safety, but various arteries and veins may cross and lie upon it. These include transverse communicating branches from the superior thyroid veins and venous plexuses above and below the isthmus, as well as arterial branches from the superior thyroid. The cricothyroid artery runs transversely across the cricothyroid membrane. Below the isthmus the thyroidea ima may be present, and at the root of the neck the left carotid and innominate arteries and the left innominate vein are in close proximity to the trachea. The thymus gland may overlie the trachea above the sternal notch. These relations are of importance in the further steps of the operation, as the principal danger is now from hemorrhage.

We prefer to open the trachea above the isthmus of the thyroid gland—the high operation. Here it is more superficial, and there are fewer large vessels in contact with it. As the isthmus usually lies upon the second and third tracheal rings, or even higher in children, it may be necessary to displace it downward or to divide it. A preliminary transverse incision along the lower border of the cricoid cartilage at this stage is of advantage, as it frees the isthmus of its fascial attachments to the cartilage. Arteries and veins must be displaced to either side, or clamped and divided. The anterior surface of the trachea is covered by a cellular tissue, which can be torn through by blunt dissection. The director and the handle of the scalpel are useful for this purpose. The trachea is then ready to be opened. All hemorrhage is first checked if possible, but in an emergency rapid sponging clears the wound suf-

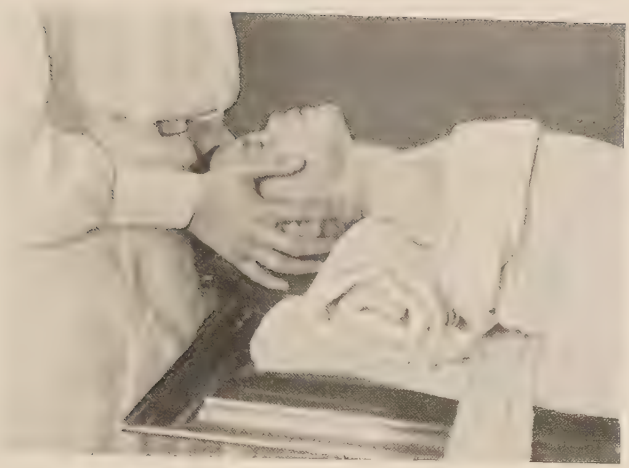


Fig. 13.—Position of patient for tracheotomy. The rolled blanket beneath shoulders and neck makes trachea prominent (McCombs).

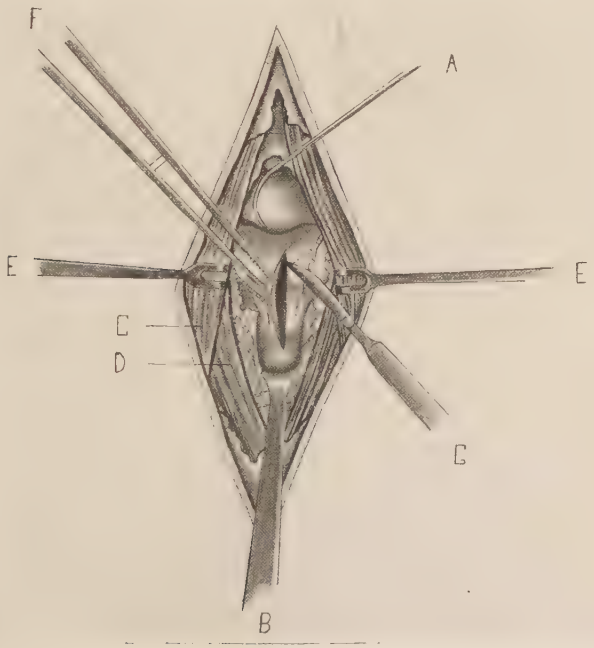


Fig. 14.—High tracheotomy: A, Tenaculum steadying cricoid cartilage; B, retractor drawing down thyroid isthmus from tracheal rings; C, sternohyoid muscle; D, sternothyroid muscle; E, E, sternohyoid and sternothyroid muscles retracted from median line; F, forceps drawing outward one lip of incised trachea; G, knife in act of increasing tracheal opening after stab-incision (Bickham).

ficiently to permit of incision of the trachea. The relief of asphyxia will be followed by rapid cessation of hemorrhage from congested venous radicles. Having ascertained that the trachea is free of intervening tissue, it is steadied and drawn forward by introducing the sharp tenaculum into it to one side of the median line, or by catching the lower border of the cricoid. The incision through the tracheal rings is made by the scalpel, or, better, with a sharp tenotome, from below upward, exactly in the median line, dividing two or three rings by a controlled cut. Division of the cricoid is very undesirable, as it may be followed by permanent injury to the larynx. This is followed by a rush of air and perhaps expulsion of mucus and membrane. In a deep wound much delay may be caused at this stage by failure to fix the trachea. If the tenaculum is intrusted to an assistant, the operator may catch the edge of the tracheal wound with the toothed forceps and introduce the tube or, better, the tracheal dilator may be used to hold the wound open while the lumen of the trachea is freed from false membrane either by the cautious use of tracheal forceps or of an applicator or a feather. A tracheotomy tube of proper size is then introduced by means of its guide, still holding the trachea steadily by the tenaculum until it is in place. Hemorrhage having been again looked for and controlled, the tube is tied in place by tapes fastened around the neck, bringing the knot to one side. A couple of silkworm-gut stitches are introduced to close the wound below the tube.

Respiration may stop during the operation, when it must be rapidly completed; or after the trachea is open, when artificial respiration will usually soon restore the rhythm. In any event, the trachea must be opened, even if the case seems hopeless, and artificial respiration persisted in until it is evident that it is useless. A small, flat dressing is placed between the shield of the tube and the wound. The child is soon relieved by the operation, and the change from a state of asphyxia to a comfortable condition is as striking as is observed in intubation cases.

After-treatment.—The temperature and surroundings are similar to those described after intubation. Great care in the nursing is a large factor in the success of the operation. Feeding is not difficult unless paralysis of the throat muscles occur, when regurgitation may take place through the tube. If there is much expectoration from the tube, the inner tube must be removed at frequent intervals—viz., every half-hour or hour—and cleansed. Between removals it is kept free of mucus by the use of an applicator or feather. Dry cases in which there is little expectoration are unfavorable, an observation made many years ago by Trousseau, later by Cohen, and verified in the antitoxin era by George Thornton. In these cases breathing is harsh and noisy, whistling sounds are heard upon coughing, and the condition is primarily due either to a membranous involvement of the trachea and bronchi or to dry inflammation of the same. Here the frequent use of steam and moisture by the croup-tent and the hand or steam atomizer is demanded, using a glycerin and soda solution (see Intubation), the tube and trachea being

also moistened by frequently introducing a feather dipped in the same solution.

If loose membrane presents in the tube, it must be removed. When there is moderate mucus expectoration it is better to avoid meddling much with the tube, except to cleanse it. The maintenance of a moist atmosphere in the room and the use of the atomizer for periods of ten or fifteen minutes every two hours will be sufficient. The outer tube need not be removed until the third or fourth day, and then only by the surgeon himself. If the larynx is free of obstruction, which can be tested by closing the wound by a gauze pad, the tube may be dispensed with, otherwise a clean tube should be introduced for two or three days longer. When the tube is removed, the child must be carefully watched for any return of obstruction. Mental agitation on the part of the patient may interfere with breathing after the removal of the tube, and tact and patience may be necessary to overcome this. In some cases a persistent obstruction is present similar to that observed in intubation cases, and due to the continuation of a hypertrophic laryngitis, subglottic in location. These cases of "retained" tracheotomy tubes are more frequent since the use of antitoxin, probably due to the more frequent recovery of cases with severe local lesions. Such cases can usually be cured by the introduction of an intubation tube, which is worn for several days or weeks, the tracheal wound meanwhile being plugged by a special obturator to keep it from closing until the child can breathe through the larynx. The beneficial action of the intubation tube in this condition has been repeatedly demonstrated.

Granulations around the wound are sometimes troublesome, and ulceration of the trachea may arise from ill-fitting tubes. The use of nitrate of silver to cut down excessive granulations will be indicated; and when large they may demand curetment. The remedy for ulceration is the substitution of a properly fitting tube. Fatal secondary hemorrhage from erosion of large vessels, usually arteries, especially of the innominate artery, may be a sequel of tracheal ulceration and perforation. Other complications are diphtheritic infection of the wound, erysipelas, cellulitis, and abscess. A mild emphysema around the wound is frequently present, and in certain cases it may be very extensive. Mediastinal emphysema may accompany such diffuse air infiltration, is accompanied by marked dyspnea, and is often fatal. Bronchopneumonia is one of the most frequent causes of death after tracheotomy. Heart-failure and extension downward of the membrane are the other most serious complications. After removal of the tube the wound soon closes.

Results of Tracheotomy and Intubation.—A just comparison of the results obtained by intubation and tracheotomy for laryngeal stenosis in diphtheria can only be made by comparing the statistics of institutions which submit all cases to one or the other operation. Siegert has done this in a large series of hospital cases, and he found the mortality practically the same—viz., about 34 per cent. The statistics of the Boston City Hospital are fairly representative of the best results obtained by

intubation in hospital practice—viz., from 67 to 74 per cent. of recoveries, and this agrees pretty closely with our own results in the average class of patients in private practice. These figures apply, of course, only to cases where antitoxin is given, and given freely, in accordance with the modern methods of treatment. Among the better class of patients treated in their homes, where antitoxin is administered early, where intubation is performed promptly, and where good nursing is obtainable, complications are few and the mortality under such circumstances is less than 20 per cent. If the patients are submitted to operation in advanced stages of toxemia, when exhausted by prolonged stenosis and with pneumonia or membranous involvement of the bronchi, the percentage of deaths is much higher. Cases submitted to secondary tracheotomy, where intubation has been done as a primary operation, and obstruction has returned below the intubation tube, show a very high mortality, running over 50 per cent. We find also a high mortality after either intubation or tracheotomy in infants under one year of age, the rate decreasing steadily up to the eighth or ninth year. In measles cases, complicated with laryngeal diphtheria and requiring operation, and in scarlet fever also the mortality is about double that of ordinary laryngeal cases.

SCARLET FEVER

SCARLATINA

By George H. Weaver, M. D.

Scarlet fever is an acute, contagious, self-limited disease. Convincing proof has not been presented to show that any one of the "specific agents" described in connection with scarlet fever is really the essential cause of the disease. Jochmann[1] reviewed the entire subject of the relationship of streptococci to scarlet fever and reached the conclusion that streptococci are the most common and dangerous cause of the secondary infections of scarlet fever, but are not the cause of the disease itself. This is the view held by most observers. Being unacquainted with the properties of the specific agent and with its location in the body of the infected individual, there is great difficulty in learning the way in which the disease is transferred from one person to others. Clinical evidence is at hand which speaks for the possibility of contagion before the disease manifests itself by symptoms, but here it is more likely that the patient acted only as a carrier of infectious material from a preceding case. During the early stage, before the eruption has appeared, the danger of contagion is not great, but becomes so when the eruptive stage has arrived. Evidence is accumulating which points to the secretions of involved mucous membranes, purulent discharges from the ear, pus from broken down lymph-glands, etc., as the agencies through which the contagion is usually transferred. The importance of epidermal scales as disseminators of infection is apparently not so great as was formerly believed. Millard[2] made a careful study of the conditions under which patients discharged from the City Hospital of Birmingham carried infection into their homes. His observations indicated that the late desquamation upon the feet was not infectious, but that most cases could be traced to a rhinitis or otorrhea which either was present when the patient was discharged or developed afterward. Subsequent observations by Millard and other British physicians who have exceptional opportunities for following large numbers of cases after discharge from isolation hospitals have fully confirmed Millard's first conclusions. Lauder[3] has acted upon his conviction that the des-

[1] Die Bakterienbefunde bei Scharlach u. ihre Bedeutung für den Krankheitsprocess, Zeit. f. klin. Med., 1905, lvi, 316.

[2] The Etiology of "Return Cases" of Scarlet Fever, Brit. Med. Jour., Sept. 3, 1898, 614.

[3] An Inquiry into the Source of Scarlatinal Infection and Its Bearing upon Hospital Treatment, Lancet, March 12, 1904, 712.

quamating skin is not infectious, and out of 204 patients sent out in a peeling condition, only two were responsible for "return cases." Mild cases in which no eruption is observed are able to spread the disease. Whatever the nature of the infecting agent, it is very resistant to drying. Contaminated clothing, dwellings, etc., retain the exciting cause of the disease in active form and capable of reproducing the disease for months and perhaps for years. The ability of the virus to resist drying renders its carriage by a third person, animals, clothing, etc., quite easy, and such transfer is not infrequent. Numerous instances are recorded in which scarlet fever has been disseminated through contaminated milk. In these cases the contagion usually, if not always, gains entrance to the milk from persons who have the disease or have been associated with persons having it. That a similar disease occurs in cows has not been established, and the evidence is opposed to such an assumption. The same is true as regards other domestic animals.

Scarlet fever appears throughout the world, but seems most prevalent in Europe and North America. The sexes are equally susceptible and social position has little influence. Epidemics are apt to be most severe in the autumn and winter, but occur at all seasons. In very young infants the disease rarely occurs. With increasing age susceptibility becomes greater, the largest proportion of cases occurring before the fifteenth year. From the fifteenth year the susceptibility decreases, and cases later than the fortieth year are very rare. In comparison with measles individual susceptibility is much less, from 35 to 50 per cent. of exposed persons escaping. Certain families appear very susceptible and exhibit severe types of the disease. One attack usually confers permanent immunity, but second and, rarely, even third attacks occur. Secondary infections or reinfections may occur in the third to the sixth week of the primary attack according to Hase.[1] Griffith[2] also has described such occurrences and insists upon the inadvisability of aggregating cases, and of placing mild and severe cases together. The relationship borne by ordinary scarlet fever and puerperal and surgical scarlet fever is still a moot question. Its final solution must await our ability to recognize the specific agent in each.

After an incubation period which is quite variable, but usually from two to seven days, the disease manifests itself by a sudden onset characterized by vomiting, fever, rapid pulse, and sore throat. In young children there may be convulsions at the beginning, and in older persons an initial chill. Early in the course of the disease there appears a marked leukocytosis, which persists throughout the attack. This is often of value in the differential diagnosis. From twelve to thirty-six hours after the onset the characteristic rash makes its appearance. It consists of minute red points upon a flushed skin, giving the impression of a diffuse scarlet color. This appears first upon the neck and chest, and spreads over the entire body, including the face, in from twelve to twenty-four hours. It

[1] Jahrb. für Kinderheilk., xxxix, 58.

[2] Secondary Rashes and Second Attacks of Scarlatina, Quarterly Med. Jour., Oct., 1895, 23.

is accompanied by severe itching or a feeling of tension in the skin. In milder cases the face may escape and the general eruption be faint and transient. The same is true in some severe and malignant cases. The eruption may sometimes be patchy, resembling measles, and rarely petechiæ or larger hemorrhages are observed. After the eruption has been at its height for two or three days, it gradually fades. With the evolution of the eruption the fever remains high and it gradually declines as the eruption fades. Soon after the eruption disappears, desquamation begins upon the chest as fine scales, and it soon extends to the rest of the body. It begins latest upon the fingers and toes, where large scales may be thrown off, and is not complete in these localities until the end of three to eight weeks. At the onset or very early in the disease there appears a diffuse redness of the entire pharynx, accompanied by minute red points upon the hard palate. There may be small grayish-yellow spots of exudate upon the tonsils which are readily removed. With the decline of the fever the angina gradually subsides. In more severe cases pseudomembranous lesions appear upon the tonsils within the first few days, sometimes rapidly extend to the adjacent mucous membranes, and are accompanied by much swelling of the tonsillar and pharyngeal tissues, enlargement of the related lymph-glands, and general septic conditions.

Among the complications of scarlet fever which occur with relative frequency are severe pseudomembranous angina, otitis, adenitis and periadenitis, and nephritis. More rarely occur gangrenous angina, laryngeal obstruction, suppurative adenitis and cervical cellulitis, arthritis either simple (rheumatic) or suppurative, endo- and pericarditis, pneumonia and pleurisy, empyema of the antrum of Highmore, empyema of the orbit, due to perforation of infected ethmoid cells or frontal sinus, symmetric gangrene, and noma. Scarlet fever may be complicated by other infectious diseases, most often diphtheria, more rarely measles, varicella, erysipelas, typhoid fever, and variola.

Scarlet fever has been said to be the most dreaded of all the infectious diseases which now prevail. It has been estimated that it causes one-twenty-fifth to one-twentieth of the entire mortality in England and America. The death-rate varies widely in different epidemics, in mild ones being from 2 to 10 per cent.; in severe ones, from 16 to 30 per cent. In the statistics given by Somerset[1] of the scarlet fever cases in hospitals in New York City from 1893 to 1899 the mortality in different quarters of these years varied from 2 to 22 per cent. The mortality among infants is high, and among poor people somewhat higher than among the well-to-do. The fatal outcome may depend upon a very virulent infection, complicating septic infections, gangrenous processes in the nasopharynx, nephritis, cardiac lesions, laryngeal obstruction, or bronchopneumonia. The mortality is very high among cases complicated by a secondary infection by diphtheria bacilli.

[1] Notes on the Hospital Scarlet Fever Service in New York City from 1893 to 1899 inclusive, New York Med. Jour., 1900, lxxii, 980.

TREATMENT

Since scarlet fever tends to terminate in recovery in uncomplicated cases, our efforts are to be directed toward a limitation of the disease to the infected individual, and toward the prevention of complications. When complications occur they must be met upon general principles. Judicious care can do much to render recovery more sure, and certain complications can be prevented in a large measure. In no disease is skilled nursing of more value.

Scarlet fever is such a treacherous disease, the mildest case sometimes terminating fatally, and so many unfortunate sequels being liable to follow, that no effort should be spared to prevent the spread of the infection from the sick. This is especially demanded because susceptibility to the disease diminishes as age increases, and if the disease can be avoided until the fifteenth year, the chances of infection are comparatively small. Purposeful exposure of children to scarlet fever is not justifiable under any circumstances. The children of a family in which a case develops should not be allowed to attend school or associate with other children. In small towns and in country places the closing of schools during the prevalence of scarlet fever is to be recommended. In large cities this measure is of doubtful utility. In the selection of persons to nurse scarlet fever patients it is desirable to choose those of more advanced years, or those who have been immunized by an attack of the disease, and to avoid young persons as far as possible. The physician should take every precaution to avoid carrying infectious material from the sick to other persons. Before going into the sick room the clothing should be protected by a long cotton gown, fitting snugly about the neck and wrists, which can be sterilized by boiling at the termination of each case. Covering the head with a cap is also desirable. After the visit is terminated the hands and face, especially the former, should be washed in soap and water, followed by an antiseptic solution. In the prophylaxis of scarlet fever, isolation of the patient is the main factor. This must include also complete isolation of the nurse, every means of contact between the sick room and the rest of the family being severed. This complete isolation can be procured in a private house if an upper floor can be set aside for the care of the patient. If this is not possible, it becomes a much more difficult matter to prevent the spread of the disease to other children in the family. Before the patient is placed in the isolating room all upholstered furniture, hangings, pictures, etc., should be removed. The less there is left in the room, the easier and more efficient will be the disinfection following recovery. After the patient has occupied the room nothing should be removed until the patient is ready to be relieved from quarantine. Bed linen and clothing may be immersed in a 2 per cent. solution of carbolic acid in which they remain for twelve hours before being removed for washing. Discharges from the throat, ear, and suppurating glands, also the urine, should be disinfected. Cloths used instead of handkerchiefs should be burned. The patient should not be relieved from quarantine until desquamation is complete and

especially not until all discharges from the ear and nose have ceased. The throat should also be free of signs of inflammation. If nephritis has been present it is best to disinfect the urine until evidence of renal inflammation has disappeared. Other children in the family who have remained well for two weeks after the sick one has been isolated should, if possible, be sent away from home before quarantine is broken and kept away for several weeks, so as to allow the convalescent child to recover completely. The child which has had scarlet fever should not be allowed to sleep with other children for some weeks after apparent recovery. When the patient is to be relieved from quarantine, he must be given a complete bath with soap and warm water. This is followed by a bath of 1:8000 solution of bichlorid of mercury with subsequent sponging with a 1:2000 solution. This in turn is washed off with plain water. Special care is required in washing the hair in a similar manner. This is most important and should never be slighted. The external auditory canals should be washed out with bichlorid solution, followed by physiologic salt solution. After completion of the bath, the patient should be taken into a clean room and dressed in clean clothing. The attendant must receive the same thorough disinfection as the patient. The room in which the patient has been confined requires thorough disinfection, including all its contents. Things which are of small value, playthings, books, and the mattress from the bed, should be burned. Bed linen, clothing, etc., which will not be injured by such treatment should be immersed in water and boiled for one hour. The room is to be disinfected according to the methods described in Volume I. Almost every physician with experience in the treatment of scarlet fever in private houses has been disappointed when he has depended too much upon simple fumigation after scarlet fever. All the surfaces in the room must, in addition, be thoroughly washed with active germicidal solutions. It must always be remembered that the virus of scarlet fever is most resistant and tenacious, and that unless the disinfection is very thorough there is no safety in bringing susceptible children into the house. In case of death from scarlet fever the body is to be wrapped in a double sheet saturated with a strong antiseptic solution and placed in a tight coffin which must not be again opened. A public funeral must not be allowed. After removal of the body the rooms occupied by the patient during the illness must be disinfected as above.

When a case of scarlet fever develops in one of a family of children, if it is impossible to isolate the sick child in the home it should be at once removed to a suitable hospital. The only other alternative is to remove the well children to another house in which there are no young people. The prompt removal of the first case frequently spares the rest of the family an attack of the disease. After the child is removed the room which had been occupied by it should be disinfected, special attention being given to the bedding, clothing, and playthings. The methods of quarantine and disinfection demanded in a hospital in which scarlet fever is treated are so precisely described by Northrup[1] that he

[1] Nothnagel's Encyclopedia of Practical Medicine, 1902, English Translation, 611.

will be quoted somewhat in detail. The methods he describes are employed in the hospital for scarlet fever and diphtheria patients in New York City. They are as follows: "Each patient has a private room, there being no wards. The laundry is in a building by itself. The disinfecting plant is also separated from the hospital, and consists of a steam-tank and formaldehyd chamber. In the former the steam is raised under pressure to a temperature of 110° C. (230° F.), and kept on for half an hour. If formaldehyd is used, the articles to be disinfected are exposed to the gas continuously for twelve hours.

"Patients are carefully examined before being admitted; and if there is any question in regard to diagnosis, they are placed in the observation room. The resident physician before entering the presence of the patient is required to wash his hands thoroughly with soap and water, followed by immersion in bichlorid solution (1:2000). A gown is supplied which buttons closely around the neck, covering the collar and enveloping the body completely, just clearing the floor. To this is added a cap arranged to cover the head and neck, exposing only the face. This, with a pair of rubber overshoes, completes the uniform. When he leaves the patient the hands and face are disinfected thoroughly and the mouth is cleansed with boric acid solution. All visitors must obey the same regulations. Ladies, if admitted at all, are required to remove their outer skirts before putting on the uniform.

"Patients are not allowed to leave until free from contagion. They are examined repeatedly, particular attention being given to the feet, which are sometimes slow in finishing desquamation. The scalp requires washing, as does the external auditory meatus, which is often found filled with desquamating epithelium in cases otherwise free from contagion. During the week preceding discharge, patients have their ears irrigated with bichlorid solution (1:8000), and the scalp shampooed on alternate days.

"On the day of discharge the following routine is adopted for adults (for children special instructions are given in each case): (1) The ears are irrigated with bichlorid solution 1:8000; (2) the scalp is shampooed with soap and water; (3) the scalp is shampooed with bichlorid 1:2000; (4) a tub-bath is given of soap and water; (5) a tub-bath is given of bichlorid solution 1:8000 for twenty minutes; (6) a sponge-bath is given of bichlorid solution 1:2000; (7) the bichlorid is sponged off with sterile water; (8) a nasal spray is given of bichlorid solution 1:8000; (9) the mouth is cleansed with saturated solution of boric acid. There is a suite of discharge rooms, used as follows: In No. 1 the patient leaves the hospital clothing. In No. 2 he is disinfected. In No. 3 he puts on freshly disinfected clothing. All clothing that can be washed is disinfected with steam. For other articles formaldehyd gas is used. Books and papers are steamed after removing the leather binding of the former. Toilet articles are treated in the same way, but jewels (rings, pins, etc.) are disinfected in pure carbolic acid. Watches are exposed to formaldehyd gas.

"In this hospital there has been no history, as far as known, of contagion from a discharged patient."

The wisdom of separating each case of scarlet fever from other cases is to be strongly urged. In this way the possible danger of reinfecting mild cases with highly virulent organisms is avoided, and the transfer of virulent agents causing secondary infection is escaped. The eating and drinking utensils should be collected and disinfected each time they are used.

Special care is to be exercised to prevent the contamination of milk by those who handle it.

If it appears that some of the measures outlined in the prophylaxis of scarlet fever are rather extreme, still they are justified by the conditions. They are warranted by the good results obtained by their conscientious use. Imperfect isolation and disinfection are not only of little value, but they give a false sense of security in the presence of danger.

In the management of the individual case of scarlet fever, our object is to prevent the occurrence of complications so far as possible, to meet them when they are unavoidable, and to support the strength of the patient until the disease has run its course. The patient should be put in bed in a light airy room, with an even temperature, well ventilated, but not drafty. The bed clothing should be rather light. The food must be almost entirely liquid and given at regular intervals. The best food is milk. It not only furnishes nourishment, but, by virtue of the water and milk-sugar which it contains, it also acts as a diuretic. Clinicians who have had large experience with scarlet fever are generally agreed that an exclusive milk diet for at least four weeks together with confinement to bed will perhaps prevent the occurrence of some cases of nephritis and will render this complication much less severe if it occurs. Baginsky[1] has emphasized the great value of these measures, and supports his assertions by extensive clinical experience. Broths and highly albuminous foods are to be interdicted. After the fourth week, milk gruel, rice, and vegetables are gradually added to the diet, and in the sixth week, if vegetables are well borne, broth, eggs, and a little meat may be allowed. Even the mildest cases should be kept in bed for three weeks, and in the fourth week, if complications are absent, the patient may be warmly clothed and allowed to leave the bed. Free drinking of water is to be encouraged, as its secretion through kidneys and skin aids in eliminating the poisonous materials from the body. The mouth is to be kept clean by the frequent use of mild antiseptic solutions. Frequent examinations of the urine should be made until the fifth week. In many hospitals there exists the very commendable practice of administering 1000 units of antidiphtheritic serum to every scarlet fever patient upon admission as a prophylactic against later infection by diphtheria. In view of the frequency and gravity of secondary infection by diphtheria bacilli in cases of scarlet fever, this practice might properly be extended to patients in private houses.

Efforts have been made to obtain a specific treatment for scarlet fever.

[1] Ueber Scharlach-Nierenentzündung, Archiv. für Kinderheilk., 1902, xxxiii, 57.

Various drugs have been advocated at different times, but have failed to stand the test of use. Acting upon the assumption that the symptoms and organic changes which occur in scarlet fever are due to a toxin which is neutralized by an antitoxin when recovery takes place, several attempts have been made to secure curative results by injecting blood-serum from convalescent patients into scarlet fever patients during the acute stage. The convalescent serum was supposed to contain antitoxin for the scarlet fever poison. While Huber and Blumenthal[1] and v. Leyden[2] are inclined to ascribe some favorable effects to the convalescent serum, Rumpel[3] and Scholz[4] have observed none. Because of the difficulty in determining with certainty that the person yielding the serum for injection is not infected with tuberculosis or syphilis, this method of treatment must be reserved for the most severe cases. Patients who are likely to recover under expectant treatment should not be subjected to the possibility of infection with these diseases.

Within the past few years there have appeared numerous reports of the use of antistreptococcus serum in cases of scarlet fever. In most instances those who have employed this remedy have done so with the purpose of combating the complicating streptococcic infection which is so frequent, and not with the idea that it would cure or cut short the original disease. While the curative value of antistreptococcus serum in pure streptococcic infections is still a matter of dispute, the most conflicting results following its use, it is hardly advisable to pass final judgment upon its value in cases of scarlet fever with secondary streptococcic infection. The antistreptococcus sera which have been most employed have been prepared in slightly different ways. Aronson's serum[5] is prepared by injecting horses with cultures rendered highly virulent by passage through mice and rabbits. Moser's serum[6] is prepared by using cultures of streptococci which have been cultivated from persons with scarlet fever and have not been passed through animals. Moser claims to have obtained favorable results from the use of his serum. Meldelsohn,[7] in coöperation with Baginsky, has reported a series of 146 cases of scarlet fever treated with antistreptococcus serum. He says that the essential symptoms of scarlet fever are uninfluenced by this treatment. Compared with a series of cases which did not receive the serum, there appears to be no influence in reducing the proportion of cases which develop the various complications. He warns against the use of the serum in cases in which the heart is affected. Heubner,[8]

[1] Berl. klin. Woch., 1897, No. 31.

[2] Die Behandlung des Scharlachs mit Reconvalescentenserum, Deut. Archiv. für Klin. Medicine, 1902, lxxiii, 616.

[3] Zur Behandlung des Scharlachs mit Reconvalescentenserum, Münch. Med. Woch., 1903, 38.

[4] Die Serumbehandlung des Scharlachs, Fortschritte der Medicin, 1903, xxi, 353.

[5] Weitere Untersuchungen über Streptococcen, Deut. Med. Woch., 1903, No. 25, 439.

[6] Ueber die Behandlung des Scharlachs mit einem Scharlachstreptococcenserum, Wiener klin. Woch., 1902, xv, 1053.

[7] Erfahrungen über die Behandlung des Scharlachs mit Antistreptococcenserum, Deut. Med. Woch., 1905, xxxi, 461.

[8] Cent. für Bakt., 1905, Referate, xxxvi, 311.

after employing for three years the various sera (Marmorek, Aronson, and Moser), has concluded that they do no good and has discontinued their use.

It is most hazardous to depend upon statistics alone for the proof of the value of any treatment in scarlet fever, especially if figures from different epidemics are used for comparison. Under the classical methods of treatment statistics have been reported which are as favorable as any obtained by the use of the serum. The phenomena ascribed to the remedy in individual cases are so often observed in the normal course of the disease that they do not furnish convincing proof of the curative power of the serum. While the curative power of antistreptococcus serum in well-developed streptococcic infections may often be slight or nil, animal experiments have shown that antistreptococcus serum may possess very positive immunizing power, and its early use in cases of scarlet fever may be of value in protecting patients against subsequent streptococcic infections, and thus sparing them some of the most fatal complications of the disease. At present it is not possible to state that the serum can certainly accomplish even this. Following the injection of the serum, arthralgia, urticaria, and rashes occur, similar to those so well known to follow injections of diphtheria antitoxin.

During the last few years the treatment of various infections by injections of the causal bacteria killed in various ways, usually by heat, has found wide use. The technic for this so-called "vaccine therapy" has been elaborated largely by Wright and his pupils. After observing the effects of injections of streptococci, killed by suspension in 25 per cent. galactose solution, in a considerable number of cases of scarlet fever, I[1] have concluded that such injections, given relatively early in the course of the disease, exert little if any influence over the later occurrence of complications due to streptococci. However, in some cases of subacute and chronic streptococcic infections which complicate scarlet fever and persist during convalescence, injections of galactose-killed streptococci, especially homologous strains, appear to exert a very pronounced curative effect. Of such killed streptococci, the suitable dose for a primary injection is about 100,000,000, and for subsequent injections the dose may be increased to 500,000,000. Too large initial doses have been observed to be followed by harmful results.

Symptomatic Treatment

In combating the symptomatic disturbances which appear in scarlet fever, and are due to the elevation of temperature and to the action of toxic substances upon the nervous and circulatory apparatus, hydrotherapy occupies the largest place. The frequency and manner of employing water will depend upon the severity of the symptoms. In mild cases in which the temperature never remains high, perhaps reaching 103.5° to 104° F. only at the onset, lukewarm baths or sponging with tepid water

[1] Weaver and Boughton, Jour. Infec. Dis., 1908, v, 608; Boughton, Jour. Infec. Dis., 1910, vii, 99.

twice a day are sufficient. If the temperature is persistently high, and accompanied by rapid pulse and marked cerebral disturbances, the best results are to be obtained by the use of cold water. The application of cold to the skin not only serves to abstract heat, but it also stimulates deeper inspiration, and this in turn relieves the heart, which beats more slowly and with increased effect. The favorable effect upon the nervous symptoms is doubtless partially dependent upon improved circulation.

The promptest results from the use of cold are obtained by means of baths, the temperature of which may vary from 68° to 59° F., according to the age of the patient. It is not well to prolong the bath more than five minutes. After removal from the bath the patient is dried quickly, returned to bed, and wrapped in a blanket. If so prompt and active an effect is not demanded, the cold sponge or cold pack may be substituted for the bath, or the sponging and bath may be used alternately. These measures should be repeated every six hours or whenever the temperature rises to 103.5° F. An ice-cap to the head often exercises a very favorable effect upon the cerebral symptoms, but has little influence over the general temperature.

The treatment of scarlet fever by means of cold water does not increase, but rather diminishes the liability to nephritis, as indicated by the experience of Leichtenstern and v. Jürgensen.[1] The contraindications to the use of cold water are given by v. Jürgensen as follows:

1. The presence of evident anatomic and especially inflammatory processes.

2. All signs of dyspnea accompanied by stenosis of the upper air-passages.

3. Hemorrhages from the nose, mouth, from eroded vessels in the neck, and in all hemorrhagic diatheses.

4. All joint inflammations.

For the relief of restlessness and sleeplessness, if hydrotherapy fails, phenacetin may be given cautiously. The erythematous angina requires little treatment, mild cleansing solutions being used as gargles or sprays. The patient may be allowed to suck small pieces of ice.

The heart must be watched, and if signs of failure appear, stimulants are to be administered. Digitalis is especially indicated if signs of cardiac dilatation occur.

COMPLICATIONS

The complications of scarlet fever add much to the dangers of the disease, and efforts to combat them comprise a large part of the active treatment. The severe pseudomembranous and gangrenous anginas call for special notice. A pseudomembrane may rapidly extend over the entire nasopharyngeal mucous membrane and is accompanied by more or less severe swelling of the underlying tissues. This is often followed by gangrene of portions of involved mucous and submucous tissues. These lesions develop relatively early in the more severe cases, and may be unassociated with diphtheria bacilli.

[1] Nothnagel's Encyclopedia of Practical Medicine, 1902, American Edition, 621.

Numerous observers have concluded that these lesions are caused by streptococci which are present in large numbers in the throat. In some of these cases streptococci are present in the blood also during life—*i. e.*, there is a true bacterial septicemia. Beside the streptococcus, pyogenic staphylococci are also found in such throats and occasionally in the blood. What part the unknown virus of scarlet fever plays in such phenomena is unknown, but from what we know of the effects of pyogenic cocci elsewhere in the body, it is natural to conclude that they are here the most important factors. The fetid odor of the breath which is present is due to decomposition of secretions and necrotic tissues. Whether anaërobic bacteria which are concerned in putrid decomposition are active agents in producing the gangrene and pseudomembranous inflammations, must be left undecided for the present. The involvement of the nasal mucous membrane gives rise to a purulent, acrid discharge from the nostrils. In the management of these conditions the general condition of the patient calls for careful consideration. As has been already said, specific antistreptococcus treatment with serum has not yielded satisfactory results. Reliance must be placed upon plenty of nourishment, principally milk, and stimulation. The value of cold baths in such cases is doubtful. They may, however, relieve marked nervous disturbances and reduce high temperature. The local treatment has for its chief object the keeping of the involved mucous membranes as free from decomposing secretions and débris as possible. This is accomplished by the use of gargles, sprays, and by irrigation of the nasopharynx and nasal fossa. The solutions employed should be bland and unirritating. Strong antiseptic solutions are not to be recommended. For nasal irrigation a soft-rubber catheter with several openings, through which a physiologic salt solution is allowed to flow, is best. This is to be repeated every four to six hours. Frequent gentle instillation of physiologic salt solution into the nose by means of a medicine dropper or pipet is free from the objection, often urged against irrigation, that it may excite infection of the middle ear. In any case the nasal cleansing must be carried out with the utmost gentleness. In many cases nasal insufflations of calomel, instead of irrigation, as recommended by McCollom, have yielded us most excellent results. The gargles and sprays for the throat are to be used at intervals of three hours. They may contain small amounts of antiseptic agents—*i. e.*, 2 per cent. of carbolic acid. Peroxid of hydrogen, diluted with three or four times its volume of water or saline solution, is useful for removing secretions and necrotic materials. It would appear to be especially indicated to counteract the activity of anaërobic bacteria. The use of copious gargles of hot water or saline solution seem to afford much relief to patients. Alcohol, diluted with six to eight times its bulk of hot water, is also an excellent cleansing agent. In the local treatment of the nose and throat it is always the cleansing of the involved surfaces which is aimed at, and thus the prevention of absorption of toxic products and of local irritation by them. Efforts to kill, by means of strong antiseptic solutions, bacteria which have invaded the tissues can only result in harm.

The tissues of the body, supported by food and stimulants, must be depended upon eventually to destroy them. Heubner[1] and others have claimed good results from injections of 3 per cent. carbolic acid twice daily into the palatine areas. For the injection a Traube cannula is employed. The object of the treatment is to allow the antiseptic to meet the streptococci in the lymph-vessels and lymph-glands and render them harmless. After using these injections for twenty years, Heubner still believes that they do good. The procedure certainly rests upon a rational basis.

Frequent bacteriologic examinations are to be made for diphtheria bacilli in all pseudomembranous anginas. Secondary infection by diphtheria bacilli is most likely to manifest itself after the first week. It is observed most often at times when diphtheria is prevalent, and the association of scarlet fever and diphtheria is often seen in several children of one family. When diphtheria bacilli are detected the prompt administration of antidiphtheria serum is demanded. Somerset's[2] statistics show that the mortality in mixed cases of scarlet fever and diphtheria may be as high as 50 per cent. This serves to emphasize the importance of great watchfulness to detect infection by diphtheria bacilli and to institute specific treatment at the earliest possible moment. Because of the large number of bacteria of various sorts in such throats, special care is demanded in securing the material for cultures from beneath the pseudomembrane. If this is not done the diphtheria bacilli will frequently be overlooked.

The slighter forms of adenitis which occur in most cases of scarlet fever call for no special treatment. With the more severe anginas a secondary adenitis occurs and may become extreme. If an ice-bag is well-borne, it should be applied in adults and older children. Moist, hot applications may be used for a short time. Incision and drainage should be instituted as soon as there is any evidence of suppuration within the gland, and it should not be delayed until the pus reaches the surface. Such wounds should be carefully dressed, and all precautions taken to prevent infection from without. Extensive cellulitis of the neck demands prompt surgical measures.

Otitis of a severe type is not infrequent as a complication of scarlet fever; it may lead to a mastoiditis. It is not so apt to occur in mild attacks with limited throat lesions, but develops in a large proportion of the cases in which there are severe pseudomembranous and gangrenous anginas. Otitis can only be prevented by measures directed toward the angina, to which it is secondary. In spite of every effort, otitis often occurs when the angina is severe. The treatment is considered on pages 320 and 776.

Slight albuminuria early in the disease is common and of little consequence. Acute postscarlatinal nephritis develops from the sixth to the thirtieth day; the majority from the fifteenth to the twentieth day, after the urine has been normal for some days. Kemp[3] has directed at-

[1] Münch. med. Woch., 1886, No. 9, 158. [2] Loc. cit., p. 312.
[3] Treatment of Scarlatinal Nephritis, Pediatrics, 1900, x, 241.

tention to what he designates the "premonitory stage" of scarlatinal nephritis. The first change noticed in the urine is fall in specific gravity, there being no albumin present and usually no fever. There may be slight anasarca, but usually there is none. Soon there follows a sudden rise in specific gravity, the urine being diminished in quantity and high in color. There is still no albumin, or only a trace, usually no anasarca or elevation of temperature. In a short time these premonitory signs are followed by those of well-developed acute nephritis. The premonitory signs can only be detected by taking the specific gravity of the urine twice daily after the middle of the second week. This can be done by a properly trained nurse, who may record the results in the same manner as she does the pulse and temperature. Nephritis seems as liable to occur after mild as severe attacks, and in some instances an acute nephritis with edema of the eyelids first directs attention to the slight angina and scarcely perceptible desquamation of the preceeding attack of scarlet fever. In the late postscarlatinal nephritis occurring in uncomplicated cases the kidneys present the appearance of a glomerulonephritis. In the cases developing early, due to a septic cause, the lesions are those of an acute interstitial nephritis. Many cases show a combination of both sorts of lesions. In the prophylaxis of nephritis the greatest emphasis is to be placed upon confinement to bed, milk diet, and hydrotherapy. That such measures actually prevent nephritis may be questioned, but that they render the disease less severe can hardly be doubted, as shown by Baginsky[1] and others. Baginsky noted that during a period of seven years, among the patients which were in his hospital from the beginning of the disease and were kept upon a strict milk diet, none developed more than a limited edema of the face, and in none was severe uremic intoxication observed.

With the first appearance of the premonitory signs, either the fall in the specific gravity of the urine or edema of the eyelids, even with no albuminuria, the indications are to secure elimination of the poisonous materials through the skin and intestines, and to spare the kidneys as much as possible. Sweats produced by warm baths or warm packs are to be given twice daily and continued one-half to one hour. Cold may be simultaneously applied to the head with advantage, especially if fever is present. After removal from the pack the patient is dried with warm towels and placed in a warm bed. Perspiration often continues some time after the bath or pack is discontinued. Baginsky warns against the sweating treatment in cases with high fever, or severe dyspnea from pleural effusions, or inflammatory complications in the respiratory organs or heart. In such cases he prefers a cool pack (85° F.) which, if continued, sometimes brings about free perspiration. He also warns against persistence in sweating if the hydrops is not relieved thereby and if the albuminuria increases. Of diuretics, milk is the best if taken freely. Alkaline mineral water or plain water with small doses of potassium citrate is to be given freely. Diuretics which may irritate the kidneys should be given very cautiously. Diuretin often produces an increased flow of urine.

[1] Ueber Scharlach-Nierenentzündung, Archiv. für Kinderheilkunde, 1902, xxxiii, 57.

If effusions into the peritoneum and pleura are large enough to be burdensome or to interfere markedly with respiration or heart action, paracentesis may be performed. From the onset of the nephritis the heart must be closely watched, and upon the appearance of signs of dilatation and failing power, heart stimulants, especially digitalis and strychnin, are to be administered. The bowels should be kept active by means of salines. With the occurrence of uremic symptoms, the treatment outlined is to be aided by measures to control the nervous symptoms. Chloral hydrate alone or combined with potassium bromid is best administered in an enema of water. It may be repeated as often as required to control the nervous symptoms. In the uremic convulsion, chloroform is to be given by inhalation to relieve the severity of the paroxysm. If the pulse is tense, and uremic symptoms pronounced and calling for prompt relief, no measure acts so quickly as venesection, 2 to 5 ounces (60 to 150 cc.) of blood being removed from a child of five years. The blood may be replaced by an intravenous injection of twice as much sterile physiologic salt solution. Following the bleeding the urine usually increases in amount. After the urgent symptoms are relieved, the patient must be closely watched until all evidence of kidney disease has been absent for some time, and the usual slow convalescence has terminated in a return to usual health. During convalescence iron is often required, and the nutrition of the patient must be attended to. Recovery may be retarded by too long administration of active diuretics and by too restricted a diet.

While most cases of postscarlatinal nephritis terminate in recovery, a larger proportion than was formerly supposed pass into a subacute or chronic nephritis. Out of 88 cases of nephritis in scarlet fever patients observed by Baginsky, at least 5 terminated in a chronic nephritis. Of 38 cases of chronic nephritis in children observed by him in the hospital, 9 could be certainly traced to a former attack of scarlet fever. When the nephritis shows a tendency to become chronic a change of climate is often useful, and if possible the patient should seek a warm climate during the winter. After apparent recovery a chronic nephritis may develop, an interval of several months elapsing between the original attack and the manifestation of the chronic disease. These facts, which have been noted by many careful clinical observers, emphasize the importance of keeping such patients under observation for a long time, during which the urine is to be examined at regular intervals.

Laryngeal obstruction is to be treated as in measles. Because of the swelling of the tonsils and tissues of the pharynx, the operation of tracheotomy may be preferable to intubation. Of the cardiac lesions, simple endocarditis is most apt to occur in cases with joint complications. The ulcerative endocarditis and pericarditis are part of a general septic process and are to be treated as when they occur elsewhere. Bronchopneumonia is also observed in septic cases, and requires management similar to that outlined for the same condition in connection with measles. Scarlatinal rheumatism, if mild, requires only warmth; if more severe, antirheumatic remedies may be administered.

MEASLES

Rubeola

By George H. Weaver, M. D.

Measles is an acute, highly contagious, self-limiting disease, the specific cause of which is unknown. From the fact that the disease occurs in the fetus of which Ballantyne[1] collected 20 cases, it is likely that the specific factor is present in the blood of the mother, reaching the fetus in this way. Hektoen's published observations[2] appear to demonstrate decisively the presence of the specific virus in the blood in ordinary cases of measles. It is almost certain that the etiologic agent is present in the secretions from the involved mucous membranes. The contagion is usually transferred directly through the air, probably by means of minute moist particles of the catarrhal secretions thrown out in the act of coughing, which remain suspended in the air for some time. The disease is contagious from the beginning of the catarrhal symptoms and becomes much less so during the eruptive stage. During desquamation it is very rare for contagion to occur. Carrying of the infection by a third person is very infrequent.

Measles is world-wide in its distribution, being endemic in large cities. It frequently occurs in extensive epidemics, which are most common and severe in the spring months and least frequent and severe during the autumn. Both sexes are equally affected. It occurs usually in childhood, very few escaping after the first exposure, but adults who have escaped in earlier life are liable to the disease. One attack usually confers an immunity against subsequent ones, but two, three, or even four attacks may occur in the same individual. Instances of measles in infants less than six months of age are rare.

Following an incubation period of from nine to ten days, the initial symptoms of fever, coryza, sneezing, discharge from the nose, redness of the eyes, increased lacrymation, photophobia, and a hoarse cough make their appearance. Koplik's spots are seen very early in the stage of invasion and are pathognomonic. They appear as minute bluish-white spots surrounded by a red zone on the buccal mucous membrane and on the inside of the lips. Very early, sometimes even before Koplik's spots appear, there is a leukopenia with a reduction in the number of lymphocytes. Three, four, or five days after the appearance of the initial symptoms—*i. e.*, twelve or thirteen days after contagion—the characteristic blotchy, maculopapular eruption appears over the

[1] Arch. of Pediat., 1893, x, p. 301.
[2] Journal of Infectious Diseases, 1905, ii, p. 238.

forehead at the border of the hair, behind the ears, and on the neck. This gradually extends over the face, to the body, and finally to the extremities. After full eruption the general symptoms subside, and the eruption gradually fades in the order of its occurrence, being followed by a fine, branny desquamation. Atypic cases occur in which the rash appears very early or is delayed; others in which the eruption is hemorrhagic, and some with most pronounced pulmonary symptoms from the onset. The other symptoms of the disease may occur without any eruption, and there may be no fever. Complications are relatively infrequent except in young children. The most common and severe is bronchopneumonia. Less frequent are membranous laryngitis, otitis, and ileocolitis. Very infrequently occur purulent conjunctivitis, nephritis, lobar pneumonia, severe ulcerative stomatitis, noma of the face and genitalia, and abscesses in the cervical lymphatic glands. Coincident or secondary infection with diphtheria, pertussis, or scarlatina may occur. Tuberculosis is a most common sequel, either a lymphatic tuberculosis, a miliary tuberculosis, or a tuberculous bronchopneumonia.

In uncomplicated cases the mortality is very slight. In young infants it may reach 20 per cent., and in institutions where unhealthy infants are affected, as high as 40 per cent. Almost all deaths result from complications.

Being unacquainted with the specific cause of the disease, and having no specific agent with which to combat the disorder, we must endeavor to prevent the spread of the disease and to avoid the occurrence of complications until the disease has run its natural course. Complications will call for such remedial measures as their characters indicate.

Measles is usually considered by the laity to be so mild and harmless that no efforts to prevent contagion are required, and as every one is almost certain to contract the disease sooner or later, they argue that it may as well be at one time as another. Although measles in older children with good health is usually mild, every effort should be made to prevent the exposure of infants and younger children, and of any child with a tuberculous tendency, or a lowered vitality from any cause. Because of the high mortality and frequent complications among children living in institutions, particular caution is to be exercised in avoiding the introduction of measles, and in eradicating it if it gains entrance. Our chief weapon in the prophylaxis of measles is isolation of the patient. This must be begun as soon as possible after the disease is suspected because of the great contagiousness from the beginning of catarrhal symptoms. The isolation must not be relaxed until all bronchial, oral, and nasal discharges have ceased. In any case the period should be four weeks from the onset. After this time the apartments should be disinfected and thoroughly aired before other children are allowed to occupy them. If a case of measles occurs in part of a children's institution, the exposed children should be isolated for three weeks after the development of the last case. In a private family the exposed children may be isolated from the sick, but should not be sent to another house where the infection would be spread if another case should develop

among them. None of the children in a family in which measles is present should be allowed to attend school or to frequent public places until it is also safe for the patient to be released from quarantine, and until three weeks has elapsed after the appearance of the last case. When a case of measles develops in a family living in such limited quarters that other children cannot be protected from exposure, the rational measure is to remove the sick child at the earliest possible moment to a suitable hospital, followed by disinfection of the premises. Because of the extreme contagiousness of the disease in its very earliest stages, such measures cannot be expected to prevent further infection in many instances. Special efforts are always to be made to avoid the infection of infants and delicate children, even though they may result in failure. The isolation of individual cases is demanded when certain complications develop, such as bronchopneumonia, ulcerative and gangrenous stomatitis, whooping-cough, and diphtheria. While the latter are universally recognized as contagious, there is much clinical evidence which indicates that the former may be so as well, especially in children whose resistance has been lowered by measles. Blumer and MacFarlane[1] have reported an epidemic of noma associated with an institutional epidemic of measles, in which no cases developed after thorough isolation was carried out.

Since measles is a self-limited disease against which no specific treatment can be brought which will shorten or ameliorate the course and severity of the disease, efforts are to be directed toward avoiding complications and meeting distressing and serious symptoms when they occur. Every patient with measles should be put to bed at the onset, and kept there during the entire course of the disease. The stay in bed should be prolonged a few days after the fever and efflorescence have disappeared and until desquamation is about completed. The patient should be kept in his room for a week or more longer. If the weather is not warm, chilling of the body must be avoided subsequently. The sick room should be kept at a temperature of about 70° F., and as airy as possible without danger of exposure to draughts. Strong light should be excluded, and if there is much injection of the conjunctiva and photophobia the room should be moderately darkened. Only such coverings as are comfortable for the patient should be employed. The diet should be liquid and given at regular intervals. Water is to be given freely. The mouth should be kept clean with mild antiseptic washes. After the fever disappears, the regular diet may be gradually resumed. During convalescence the urine should be examined in order that a nephritis may not be overlooked.

SYMPTOMATIC TREATMENT

The cough which is sometimes so troublesome is usually best controlled by a simple cough mixture containing a dose of paregoric suitable to the age of the child. If there is considerable conjunctivitis, it may be

[1] Amer. Jour. Med. Sciences, 1901, cxxii, 527.

much relieved by bathing the eyes with a warm saturated solution of boric acid, or a physiologic solution of sodium chlorid. The edges of the lids may be anointed with vaselin at night to prevent agglutination and irritation by dried secretions. Small doses of antipyrin or phenacetin may be employed to relieve the discomfort and headache caused by the fever. Bromids are most useful for the relief of the insomnia and restlessness.

Warm sponge baths add much to the comfort of the patient, and if given without undue exposure can do no harm. The intense itching and burning of the skin which are apt to be present during the efflorescence may be relieved by adding soda or salt to the warm water used for bathing, or by anointing the body with oil or vaselin. Diarrhea, if present, is usually readily controlled by small doses of paregoric. It usually subsides after the eruption has fully developed. Constipation is best met by enemas of warm water with soap or by glycerin suppositories. Especially in the earlier stages active catharsis is to be avoided, as a troublesome diarrhea may be started in this way. The fever rarely reaches a dangerous height, but if it causes much nervous disturbance it is best counteracted by ice to the head, and by tepid sponging and bathing. The temperature of the bath should be gradually reduced rom 95° to 80° F. The effects upon the patient rather than the height of the fever should determine the activity and scope of measures taken to control it. If the bath is followed by lividity and collapse, small doses of diffusible stimulants and the external application of heat may be required.

COMPLICATIONS

A large part of the active treatment required in cases of measles is directed toward combating complications, some of which are relatively frequent in young children and responsible for most fatalities associated with the disease. The most common and fatal of these complications occur within the lungs in the shape of bronchopneumonia, due to a secondary or complicating infection with pyogenic staphylococci and streptococci, and with pneumococci. These organisms find a suitable soil in the pulmonary organs altered by measles. If the bronchopneumonia is mild and unaccompanied by high fever and much prostration, little special treatment is demanded. If the fever is high and accompanied by nervous disturbances, delirium, twitching, etc., it is best reduced by means of cold water, which also exerts a favorable effect upon the nervous system and the heart. In an infant this may be employed as a bath, beginning with a temperature of 100° F. and gradually lowering it to 85° F. by adding cold water. During the bath a cloth wrung from cold water and frequently changed is to be kept upon the head, and friction is to be applied to the extremities. After from five to ten minutes the child is removed and wrapped in a warm blanket, with a hot-water bag to the feet. In older children sponging with tepid water, a cold pack, or the application of an ice-bag to the chest is usually better borne and accomplishes as good results. The ice-bag should be separated from

the skin by a layer of flannel. Cold may be continuously applied to the head and is valuable in allaying nervous symptoms. If high temperature is associated with cold extremities, blueness of the skin, and a weak pulse, a hot bath containing mustard is to be given, the surface of the extremities being vigorously rubbed while the child is therein, and cold being simultaneously applied to the head. In all but the mildest cases stimulants are required, the amount being determined by the character of the pulse. The administration of stimulants should not be too long delayed; smaller doses begun earlier accomplish more than larger ones later. The most reliable stimulant is strychnin in doses of $\frac{1}{300}$ gr. for a child of one year, and proportionately larger doses for older patients. It is often well combined with alcohol. Of external applications, the most useful is a dilute mustard paste covering the entire chest, and allowed to remain until the skin is reddened. It is very important to administer liquid nourishment in small quantities at regular intervals. Expectorant remedies are usually objectionable, as they are apt to disturb the stomach. Oxygen is valuable and is best administered with slight dilution by air, giving it five minutes out of every fifteen or twenty. If dyspnea is severe, oxygen may be administered continuously. It gives the best results if begun early and not adopted as a measure of last resort.

Another complication of measles which is not very infrequent is membranous laryngitis. From its onset it demands active treatment. Diphtheria antitoxin should be administered at once without waiting for a bacteriologic diagnosis, and every case should be isolated as if it were known to be diphtheria. Calomel fumigations, as first suggested by Corbin, are to be repeated every one, two, or three hours, according to the urgency of the case. This will be especially useful if the process is due to streptococci, as is apt to be the case if the laryngeal complication has appeared early in the course of the measles, since in such a case little relief can be expected from diphtheria antitoxin. If the laryngeal obstruction appears later in the disease the likelihood of diphtheria being the cause is very great, since such cases of diphtheria complicating measles most often appear toward the end of the first week of the measles. The calomel fumigations are carried out by liberating calomel fumes in confined air which the patient breathes. The patient is well wrapped up so as to expose only the face to the fumes, and is placed beneath a tight tent within which the calomel is vaporized. The volatilization of the calomel may be effected by means of an Ermold lamp, or the calomel may be placed upon a piece of sheet metal or tin laid across the top of a tin or porcelain dish, and an alcohol lamp lighted beneath it. From 10 to 15 gr. should be vaporized each time in a tent which covers an ordinary infant's crib, and more for larger spaces. After the calomel has been vaporized, which requires about fifteen minutes, the tent is to be freely opened and the room thoroughly ventilated. Great caution must always be taken to avoid fire from the lamp, and the attendant must avoid inhaling any of the fumes. As long as this treatment is being used, a mouth-wash of chlorate of potassium solution should

be used freely. Salivation is not liable to occur in infants and young children, but the mercury may exert depressing effects. If dyspnea increases under these measures, intubation should be performed. This must not be delayed until cyanosis appears, but the relief which it affords should be obtained early, as soon as there is evidence of obstruction as indicated by the recession of the weaker parts of the chest wall during inspiration. If intubation fail to relieve, tracheotomy may be required. Northrup[1] has reported very favorable results following the systematic immunizing with diphtheria antitoxin of all children except nurslings exposed to measles. This would seem to be a wise precaution in any case when diphtheria is at all prevalent, and especially in institutions. For several years in the Cook County Hospital of Chicago each patient admitted with measles has received an immunizing dose of antidiphtheritic serum. As a result, the development of diphtheria in patients with measles, which was previously not infrequent, has been practically eliminated.

Otitis is a complication of measles which occurs with variable frequency. Efforts to relieve it are to be first made by the application of dry heat. This is best accomplished by using heated, loosely filled bags of salt with cotton interposed. A few drops of a 5 per cent. solution of carbolic acid in glycerin may be dropped into the ear. This depletes the vessels of the tympanum, while the carbolic acid acts as an anodyne and is antiseptic. If pain is not relived in twenty-four hours and there is injection and bulging of the drum-head, paracentesis is to be performed. Drainage is now to be encouraged by small pieces of twisted absorbent cotton passed loosely into the external canal, and frequently changed. Simultaneously the nasopharynx should be frequently cleansed by a gargle or spray of a dilute antiseptic solution, such as Seiler's.

If purulent conjunctivitis develops, there should be instituted frequent washing with saturated solution of boric acid or physiologic solution of sodium chlorid. Three times a day a 15 to 20 per cent. solution of argyrol may be dropped into the eye with good results.

Acute nephritis rarely complicates measles, and is to be treated as when due to other causes. Suppurative cervical adenitis may occur and calls for incision and drainage as soon as pus is demonstrated. If aphthous inflammation of the mouth appear, it should receive careful treatment. Ulcerative stomatitis is observed in cases of measles and always demands prompt attention. It is well known that it may serve as the starting-point of a gangrenous process, and this can probably be largely prevented by active treatment of the stomatitis at the onset. Chlorate of potassium is considered by many to be almost a specific for this condition, and is to be given in 2-gr. doses largely diluted every two hours. Besides this the mouth should be kept clean with mild antiseptic washes. Because of the presence of anaërobic bacteria in these cases the use of diluted hydrogen peroxid is to be recommended. If gangrenous processes should appear, active measures are to be instituted without delay. If the disease progresses in spite

[1] Medical News, 1897, lxxi, 817.

of local measures after twenty-four hours, free excision through healthy tissues followed by the actual cautery is the best treatment. This must be done with the aid of an anesthetic, and has yielded good results in the hands of Ranke and others. If the operative measures are delayed, less favorable results can be expected. In the treatment of corresponding conditions of the external genitalia of girls, the same measures are to be adopted. In all cases of measles the buccal cavity, and in girls the external genitalia, should be carefully inspected daily in order to detect any ulcerative lesions at the earliest moment. This is especially important in weakly children and in hospital patients, among whom most cases of gangrenous stomatitis and vulvitis occur. Since Petruschky and Freymuth[1] and Walsh[2] have found the diphtheria bacillus in association with noma cases complicating measles, all pseudomembranous and gangrenous lesions of the mouth and genitals should be examined for diphtheria bacilli, and if they are found, diphtheria antitoxin in full doses should be given. The authors referred to have observed favorable results follow such treatment, although it is not likely that most cases are caused by diphtheria bacilli.[3]

It is well known that tuberculosis often appears clinically after an attack of measles, either as an involvement of serous membranes or of lymph-glands, as a miliary tuberculosis, or as a tuberculous bronchopneumonia. These must be treated as when they occur under other circumstances. Fever and cough persisting after measles are always sufficient to excite suspicion of tuberculosis, and patients with such symptoms are best sent to a dry, warm climate, where they may receive proper attention. Until the patient who is convalescent from measles has regained his usual good health the directing care of the physician should not be relaxed.

As already indicated, the prophylactic measures must be varied according to the social conditions of the patient. In infants the greatest care is required in avoiding and promptly meeting complications. Where there is a tuberculous family history, especial watchfulness is demanded, particularly during convalescence, for any indication of developing tuberculous disease. As gangrenous stomatitis and vulvitis are prone to develop in children who are below par because of chronic tuberculosis, inherited syphilis, etc., such children are to be closely watched for the early signs of these conditions, and to be actively treated if they appear. Such children demand supporting measures during the course of the disease, including abundant liquid nourishment, and stimulating and tonic measures during convalescence.

[1] Deut. med. Woch., 1898, xxiv, 232; also 1898, xxiv, 600.

[2] Proceedings of the Pathological Society of Phila., 1901, iv, 179.

[3] A detailed discussion of these ulceromembranous and gangrenous conditions will be found in the following articles: Weaver and Tunnicliff, Jour. Infect. Dis., 1905, ii, 446; Ibid., 1907, iv, 8; Jour. Am. Med. Assoc., Feb. 17, 1906.

RÖTHELN

Rubella

By George H. Weaver, M. D.

Rötheln is an acute, moderately contagious, self-limited disease, the cause of which is unknown. This disease is known in Europe and America. It is very rarely observed outside of epidemics, which are most apt to occur in the winter and spring. The contagion is greatest during the early stage. It is rare in young infants and, aside from this, is liable to occur at any age. Permanent immunity seems to follow one attack.

After an incubation of from fourteen to twenty-one days there appears, with scarcely any prodromal symptoms, a rash which resembles measles somewhat, but may be mistaken for scarlet fever. It appears first on the face and consists of macular or punctiform light red lesions. From the face it spreads over the body and extremities in twenty-four hours or less. It fades in the order of appearance after one to three days. With the eruption there are associated slight febrile symptoms, catarrhal redness of the throat, and there may be some respiratory catarrh. The superficial auricular and sometimes other lymph-glands are enlarged. There may be enlargement of the spleen. Limited desquamation follows. Fatal cases are very rare and usually dependent upon pulmonary complications.

The disease usually requires no treatment. Isolation is hardly necessary. Complications are very few and are to be met as in other diseases.

TUBERCULOSIS

By Edward Osgood Otis, A.B., M.D.

Tuberculosis is an infectious disease caused by the Bacillus tuberculosis. The terms "infectious," "contagious," "communicable" are used indiscriminately with regard to tuberculosis, and all mean the same thing, although the term "communicable" is the more accurate. The infection is a slow one, of indefinite incubation, and after the implantation of the specific germ it may be weeks, months, years, or never before any active manifestations of the disease appear.

It is probable that most every one some time during his life becomes infected with the tubercle bacillus, such is its universal dissemination. Nägeli, for example, from a series of autopsies, found that 90 per cent. showed latent or healed tuberculous foci.

If such is a fact, then it is evident that with the majority of persons the infection is speedily overcome and was only indicated at the time by a transitory or obscure illness.

When this microörganism becomes effective by reason of a "favorable soil," it produces a specific inflammation characterized by a new formation of tissue, either in the form of tubercle or of a diffuse tuberculous exudation. These new products undergo further change, resulting in caseation and sclerosis. In the former we may have softening, destruction, encapsulation by means of a fibroid envelope, or calcification; in the latter, a transformation of the tubercle or exudate into a cicatricial fibroid tissue. In fact, these two processes generally go on together, and the course of the disease depends upon which is predominant. Nature produces her cure by the overthrow of the caseous tendency through the stronger fibrous one, and in obsolete tuberculous lesions of the lungs met with at autopsies a fibroid induration at the apex of the lung or a caseous nodule encased in a fibroid envelope is all that remains of a previous tuberculous focus.

Following the example of nature, art has attempted to create or stimulate a tendency to fibrosis, or an arthritic diathesis, by various drugs supposed to be peculiarly effective in this direction. For example, Harper suggested and used pure urea for this purpose,[1] though without appreciable effect. Arsenic and the hypophosphites are other drugs which have been employed, and many other suggested methods of treatment are based upon this theory.

The infection may become general, as in acute miliary tuberculosis;

[1] Lancet, March 9, 1901.

but commonly, at first at least, it is local, as in a tuberculous joint or a lung apex. In the lungs, the most common seat of tuberculosis and where it is most important clinically, the destructive processes caused by the bacillus prepare an inviting medium for other microörganisms, principally the streptococcus, staphylococcus, pneumococcus, Micrococcus catarrhalis, and others.

This secondary or "mixed" infection gives rise to characteristic symptoms of a septic nature, the "hectic fever." Although there is a difference of opinion regarding the rôle played by the introduction into tuberculous tissue of other microörganisms, still the view is generally held that the "mixed" infection is the immediate cause of the fatal result in the great majority of cases. Whether or not a pure tubercle bacillus infection, without the presence of other bacteria, is accompanied by fever or other constitutional disturbance may be a debatable question. It is probable, however, as Petruschky has observed,[1] that the first implantation of the tubercle bacillus in the organism is, in many cases, without fever. As, however, the tuberculosis extends from the primary infection and reaches a certain time-period, it is likewise probable that it is accompanied by fever— the initial fever. Further corroboration of this is the fact that a rise of temperature follows the injection of tuberculin if there is any tuberculous focus in the body, and, furthermore, high fever, as is well known, is a marked symptom in miliary tuberculosis, which is a pure tubercle bacillus infection. Later in the disease we have, as has just been said, the fever arising from the presence of other bacteria— the "hectic" fever of the mixed infection.

Infection probably rarely, if ever, occurs from a transitory exposure to the bacillus or in the open air, for sunlight and diffused light rapidly destroy the germs. It is by a continuous and oft-repeated exposure, as in infected houses or workshops, that the disease is contracted. Flick has well named consumption a "house disease."[2] The observation is a common one of one member of the household becoming tuberculous after long confinement in the house, breathing a bacilli-laden atmosphere, while caring for another member of the family suffering from the disease. The cause of these numerous cases in the same family was formerly ascribed to inheritance—we know now it is infection.

Moreover, even with continual exposure to the infection, only a certain proportion of persons will develop the disease; there must exist at the same time a receptive state, which may be the result of an inherited or acquired susceptibility—more frequently the latter. Genuine inheritance of tuberculosis is extremely rare (although late observations would seem to indicate that the tubercle bacillus is not so infrequent in the placentæ of tuberculous women), and we can only ascribe to a tuberculous ancestry a predisposition to the disease or a favorable soil; but, on the other hand, in justice we must remember that a tuberculous inheritance may, in some instances, give us a kind of relative immunity.

[1] Vorträge zur Tuberculose-Bekampfung, Leipzig, 1900.

[2] House Infection of Tuberculosis, Lawrence F. Flick, Medical News, N. Y., Feb. 20, 1904.

Whatever causes—and they are numerous—produce a deterioration of the normal standard of health and depress the resisting power of man work toward the preparation of a favorable soil, and it is the conjunction of the seed and the "good soil" which results in the production of tuberculosis. In the endeavor to convert a receptive organism into a resistant one lies the whole theory of the present hygienic-dietetic treatment.

The sources of infection are from human beings suffering from various forms of tuberculosis, principally from the sputum in the pulmonary form, and probably to a limited extent from animals, chiefly through cow's milk. Since Koch's memorable paper in 1901, at the Congress of Tuberculosis in London, the question of the infectiousness of bovine bacilli to man is still under discussion and is still undergoing investigation. The weight of evidence and opinion, however, seems to be in favor of such infectiousness, and in practice we act upon this assumption. As a result of the researches of the German Imperial Board of Health with regard to the relations between human and animal tuberculosis,[1] the conclusion was reached that tubercle bacilli of the bovine type were found in a very small proportion of cases of human tuberculosis, and these cases occurred in children under seven years of age, with one doubtful exception. The English Royal Commission on Tuberculosis, however, in its second interim report (1907), concludes that "There can be no doubt that in a certain number of cases the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction into the human body of the bacillus of bovine tuberculosis."

How large a causative factor tuberculous milk is in the infection of children is still an undetermined question. The English commission just mentioned declare that "in the majority, at least, of cases of bovine tuberculosis in the human being the bacillus is introduced through cow's milk." Nathan Raw, of Liverpool,[2] advances the theory, also held by other authorities, that "the human body is affected by two varieties of tubercle bacillus, one producing phthisis pulmonalis and generally attacking adults, the other, bovine tubercle bacillus, attacking children during the milk-drinking period and producing bovine tuberculosis in them." Von Bering regards milk as a very important cause, believing that the tuberculosis of later life is very frequently the result of milk infection in infancy; not always, however, by milk from tuberculous cows, but also by milk and food contaminated by infected dust in the street or house.

It is the sputum from a tuberculous human being, however, which is the main source of infection; and, as pulmonary tuberculosis is coextensive with civilization, the tubercle bacillus is omnipresent. The tubercle bacilli gain access to the body through—(*a*) The respiratory tract, by inhalation; (*b*) the alimentary canal, by ingestion, and, rarely (*c*), the skin, by inoculation.

There is still considerable difference of opinion as to the relative frequency of the inhalation and ingestion mode of infection, but the for-

[1] Tuberculosis, Berlin, March and April, 1905, pp. 75 and 152.
[2] Human and Bovine Tuberculosis, Tuberculosis, Berlin, November, 1904, p. 492.

mer, the respiratory route, is generally regarded as the most frequent and important one, and hence the aërogenic source of infection is to be regarded as the most common, and our prophylactic measures should be directed toward dust which may hold in suspension the bacillus. It must be remembered that this infected dust may also be deposited upon articles of food, and the tubercle bacilli by this means enter the body by ingestion.

Once in the body, the distribution of the tubercle bacilli from the original focus takes place by means of the blood, the lymphatics, and by the natural channels, most frequently through the latter two avenues.

Walsham,[1] Wassermann, and many other phthisiologists have shown that in many cases the infection reaches the lungs through the tonsils, either from without or through the blood-stream, as in acute miliary tuberculosis. When the tonsils are tuberculous, the cervical glands become secondarily involved through the lymphatics coming from these organs. Again, the lungs may become directly infected through a primary infection in the bronchial or mesenteric glands. Wherever the primary lesion may have been, or however it may have occurred, in the greater number of cases the lungs sooner or later become involved. It is well to bear in mind the various sources and channels of infection as guides in our efforts at prevention.

There are many influences, both psychic and physical, acting from within the body and through the environment, which predispose one o tuberculosis, some of which are: Vicious personal habits, such as overwork, underfeeding, lack of sunshine and fresh air, insufficient sleep, the abuse of alcohol; certain previous diseases, as diabetes, recurrent bronchitis, measles, whooping-cough, etc.; unsanitary surroundings; density of population; unwholesome occupations as the dusty trades; a climate permitting but limited outdoor life. The greatest prevalence of pulmonary tuberculosis is between the ages of fifteen and thirty-five or forty years.

Two lines of attack have been employed in the treatment of tuberculosis: first, that directed toward the infection itself—the tubercle bacillus—either by means of specifics or antiseptics, or the establishment of immunity by the use of antitoxins or serums; second, that directed toward the individual to restore the normal resistance of the organism, the so-called "hygienic-dietetic" or "open-air" treatment. The first method has never been, and the future can only decide whether it ever will be, successful; the second one has been eminently so, and is the established method of the day. It is not only the natural course of treatment from the etiology of the disease, but abundant experience has proved its efficacy.

[1] The Channels of Infection in Tuberculosis, N. Y., 1905.

Pulmonary Tuberculosis

PROPHYLAXIS: INDIVIDUAL; GENERAL

Individual.—As it requires the presence of the tubercle bacillus in effective dosage and a more or less prolonged exposure to it in a confined space, such as a house, shop, or factory, together with a receptive medium—a favorable soil—to produce an infection, we have to consider, under the head of prophylaxis, both the means of avoiding exposure to the bacillus as well as the maintenance of the general health to such a standard as will render it resistant to the infecting microörganism.

As has been said above, tuberculosis is a house disease, and it is in the unsanitary dwellings, as in tenement houses, and in whatever inclosed spaces that people congregate and remain for a length of time without constant and sufficient ventilation, that the danger from the bacillus is to be encountered and combated. Besides the presence of the tuberculous individual, and the always possible air-infection from the dried sputum, the bacillus may be brought into the house in numberless ways: trailing skirts; one's footwear, as shown by Denny and Nyhen[1]; garments from an infected tailor's shop; various tangible objects, as a sputum-infected handkerchief; on the food and in the milk; through the medium of flies. Then, also, there is always the liability of the stray tuberculous visitor, who, by spraying tubercle bacilli in the air through the cough (the drop infection of Flügge), or the shaking of a handkerchief with dried sputum upon it, or careless spitting, produces an infected atmosphere. In halls, churches, schools, workshops, stores, banks, waiting-rooms, and wherever many persons are collected, there is the ever-present danger that one or more members of the assembly may be tuberculous, and may infect the air by carelessness in the disposal of the sputum.

Whereas the tubercle bacillus is ubiquitous, we must bear in mind that it is not the momentary exposure to it which generally produces infection, but the constant breathing, continued day after day, of the bacilli-laden dust, as, for example, in a room with a bed-ridden consumptive, or in a shop beside a fellow-workman suffering from the disease; in school, with a consumptive scholar or teacher; through a tuberculous servant in the household, or a waiter in a hotel. Almost any practitioner of large experience can doubtless recall cases of probable infection through these or similar sources of exposure. It is always to be remembered, however, that the immediate environment of an uncleanly consumptive is the most common and greatest source of infection. Out-of-doors, in congested areas of large cities, there is always tuberculous sputum scattered about, but wherever the sunshine and light can reach, the bacilli are soon destroyed; so there is probably very slight danger of contracting tuberculosis in the open air, even in crowded districts, but

[1] The Transmission of Infection by Means of Footwear, by Dr. Francis P. Denny and Mr. J. Albert C. Nyhen, Brookline Board of Health Laboratory, 1904.

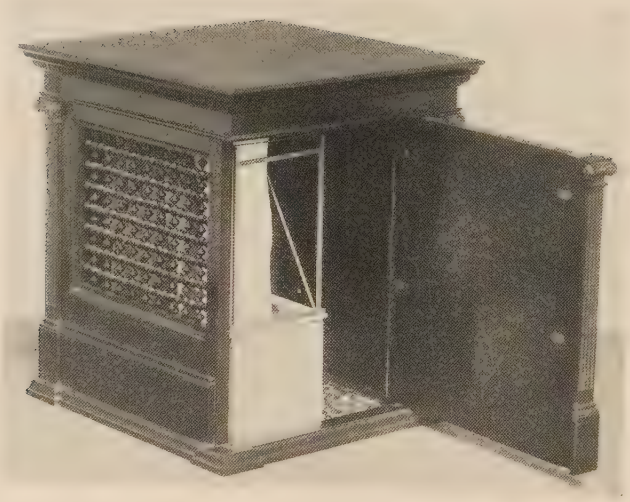


Fig. 15.—Barnes' humidifier.

in sunless, damp, unventilated rooms the bacillus thrives best and maintains its viability for a long time, even many months.

When one can choose, the dwelling should be upon a dry foundation and receive an abundance of sunshine, air, and light. The interior furnishings should be simple and capable of being easily cleaned. All dusting and sweeping should be done with a moist cloth and wet broom, or a "dustless" dust-cloth and mop. Several times a day a complete change of air should be effected by means of the open windows or doors. If the heating is by hot air or direct radiation, the parched air thus produced should be moistened by some simple plan for the evaporation of water or through the escape of steam. A porous pot containing water placed under the furnace register, or the so-called "Barnes' humidifier" (Fig. 15), an apparatus for the evaporation of water by a series of wicks in a pan of water over the furnace register, is a useful arrangement. In living and sleeping rooms the air should be maintained at a fixed temperature, and if the relative humidity is increased

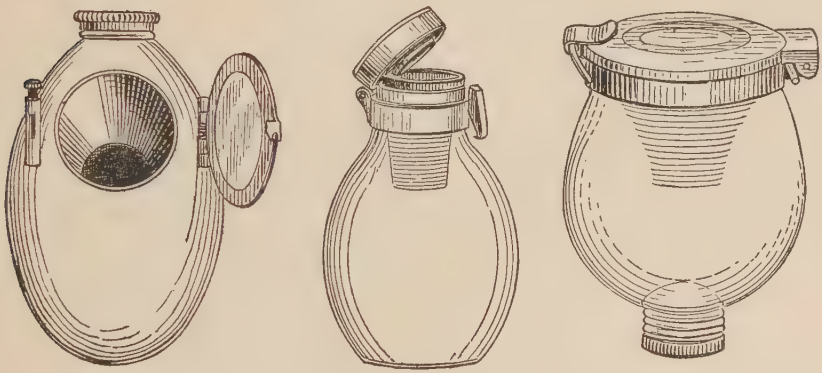


Fig. 16.—Pocket spit-cups (Kny-Scheerer Co.).

by some of the means mentioned above, a lower temperature will be more comfortable and wholesome than a higher one in a very dry atmosphere. In brief, an abundance of fresh air, light, sunshine, nourishing food, bathing, exercise, sleep, and a contented mind are the natural means to maintain the natural immunity from tuberculosis, as, indeed, immunity from most other diseases.

When a case of pulmonary tuberculosis exists in the house, the one thing to do is to avoid any dissemination of dried sputum, and the more perfectly this is accomplished, the safer the household from infection and the patient from reinfection. If the tuberculous person is a walking consumptive, he has not only to consider his household, but the shop or factory where he is employed, if he is obliged and able to work. He should be provided with some receptacle for depositing the sputum, either one of the numerous pocket-sputum flasks (Figs. 16–19) or envelopes, or, better, a number of Japanese paper napkins and a paper bag impervious to water. In the writer's opinion this last

method is the cheapest as well as the cleanest. A new napkin is used for each expectoration and each coughing paroxysm, and immediately placed in the paper bag, which is burned with its contents at frequent intervals. At the work-bench or office a cuspidor may be used if it always contains a little water and is daily cleaned. Tubercle bacilli in water are like flies on a sticking paper—they must become free and mingle in the dust before they can begin their migratory career. All cuspidors, as well as hand or table spit-cups, should be covered.

André[1] has shown that flies fed on sputum evacuate considerable quantities of bacilli in their excretions, appearing six hours after the injection of the sputum, and some are found as long as five days later. He also found that food polluted by flies that had been fed on sputum contained infective bacilli and produced tuberculosis in guinea-pigs.

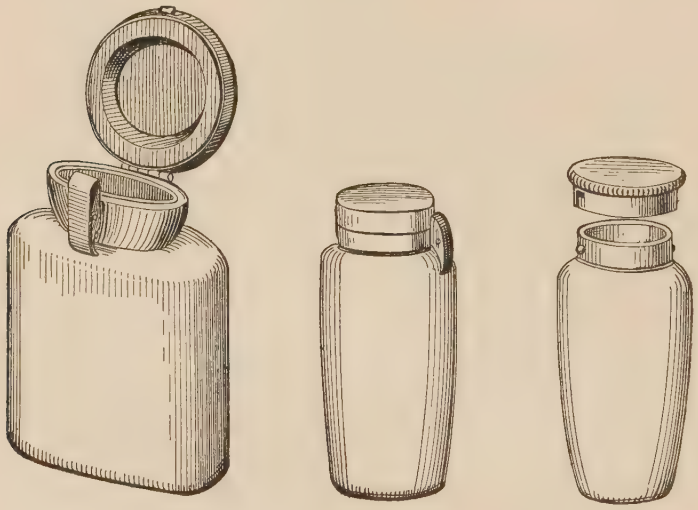


Fig. 17.—Knopf's and other pocket spit-cups (Kny-Scheerer Co.).

Flies readily absorb bacilli contained in dry dust, hence flies should be destroyed as completely as possible. Food-stuffs should be protected, and sputum-cups covered, or the sputum disinfected.

Tubercle material can also be disseminated mechanically on the bodies of flies. "Wherever the fly is there will be found tuberculosis," says Cobb.[2]

The use of chemical disinfectants in cuspidors or flasks is, for various and obvious reasons, generally undesirable. Some, as corrosive sublimate, are ineffectual, and others, like chlorinated lime, which is perhaps the best, are not always reliable and the odor is objectionable. Moreover, there is always danger in having poisonous substances

[1] Proceedings of the Sixth International Congress on Tuberculosis, 1908, vol. i, part i, p. 162.

[2] Is the Common House Fly a Factor in the Spread of Tuberculosis? J. O. Cobb, American Medicine, March 25, 1905.

about the household. For house or table spit-cups, particularly for bed-ridden patients, the pasteboard or thick paper boxes are cheap and serviceable, and can be burnt after use. A tin frame with cover and

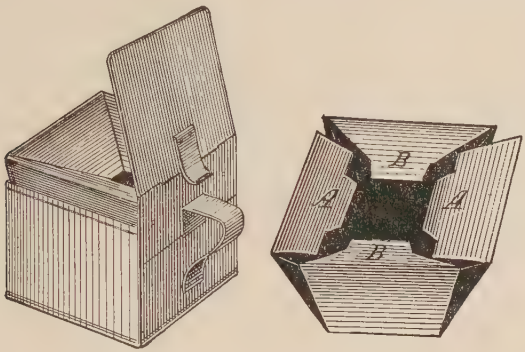


Fig. 18.—Spit-cup.

handle renders them more convenient. (See Fig. 18.) A covered cup or mug of large base, with a little water in the bottom, is also satisfactory; other forms are shown in Fig. 19.

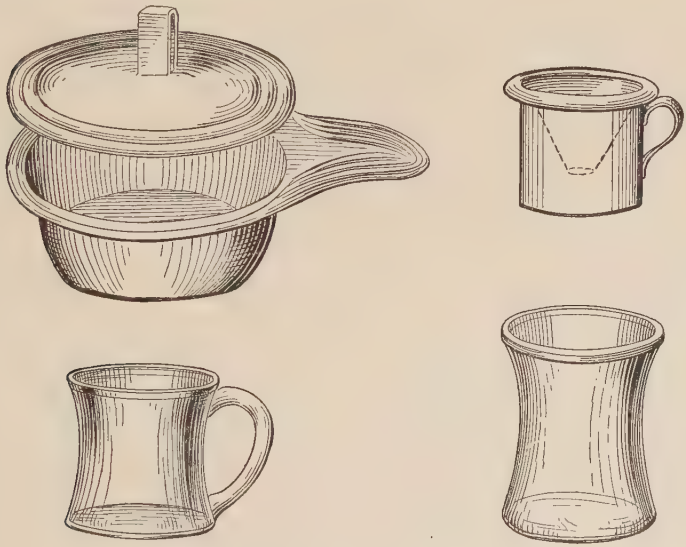


Fig. 19.—House spit-cups (Kny-Scheerer Co.).

Whatever the sputum receptacle used, and which is to be continued in use indefinitely, after its contents have been removed and destroyed it should be boiled for half an hour in water to which a little washing-soda has been added. The only safe and reliable method of destroying the sputum is to burn it.

The consumptive should maintain scrupulous personal cleanliness and pay especial attention to the care of his hands and hair. Neither beard nor mustache should be worn. In wiping the mouth after coughing, the Japanese napkins or pieces of cloth should be used as in expectorating, and the mouth and nose should be frequently washed with some bland antiseptic fluid.

When coughing, the consumptive should hold a piece of cloth or gauze before the mouth, for the fine particles of saliva thrown out in the act of coughing have been shown to contain tubercle bacilli. As far as possible, one should repress coughing in public, which, by practice, can to a large extent be done.

Whether the consumptive is bedridden or about and following his occupation, he should, if possible, occupy a room by himself, or at least a bed alone, and the bed and body clothing should be periodically disinfected by boiling or steam. The laundry of the patient should be kept separate and disinfected by steam or boiling before being sent to the wash. The frequent cases of tuberculosis in laundries may in part be ascribed to the possible cause of infected linen. So, also, should the eating utensils used by the consumptive be kept separate and washed in boiling water after use. The sputum under no circumstances should be swallowed, for intestinal infection may occur in this way, and it would be better after every expectoration to wash out the mouth if it were possible to do so.

In maintaining a high standard of individual prophylaxis, the firm coöperation of the patient can often be secured by impressing upon him the fact that he is likely to be the worst if not the only sufferer by any inadvertence on his part regarding the prophylactic régime, as he may reinfect himself if he is careless about his sputum.

Kissing on the mouth is generally regarded as one of the prohibitive acts for consumptives. Flick also included hand-shaking. The risks in either of these processes are probably very slight.

All these details of personal hygiene and prophylaxis can be summed up in one word—cleanliness.

"Before any vice," says Oliver Wendell Holmes, "can fasten on a man, body, mind, or moral nature must be debilitated." It is the debilitated body, either by inheritance or acquired, which offers the favorable soil for tuberculosis, and in any effort at prevention the body must be brought back to and maintained at the resistant level.

We begin with the infant. If its mother is tuberculous, it must be removed from her and placed under a hygienically favorable environment, where it can have pure, fresh air, sunshine, and cleanliness. Unless the milk is obtained from sources known to be free from tuberculosis, it must be sterilized by boiling or pasteurized. The method of sterilizing recommended by the British National Association for the Prevention of Consumption is herewith given as an easy and reliable one: "(1) Use a double milk saucepan; if, however, this cannot be obtained, put the milk into an ordinary covered saucepan and place it inside a larger vessel con-

taining water. (2) Let the water in the outer pan be cold when placed on the fire. (3) Bring the water up to the boil, and maintain it at this point for four minutes without removing the lid of the inner milk pan. (4) Cool the milk down quickly by placing the inner pan in one or two changes of cold water without removing the lid. (5) When cooled down, aërate the milk by stirring well with a spoon." There are many forms of sterilizers on the market, but in order to be effective they should be capable of maintaining a temperature of 185° F. for five minutes. If the milked is pasteurized, which if properly done destroys pathogenic microorganisms without injury to its composition or quality and without effect upon its food-value, it should be heated to 155° F. for twenty minutes.

By much exposure to the open air during the day and sleeping with open windows at night, the child is hardened and a resistant soil is in the process of making.

During the transition from the first to the second dentition great care must be exercised in keeping the child's mouth clean, for the spaces from which the first or milk teeth have been removed afford easy access to the bacilli, as also do the spongy masses of adenoid tissue and enlarged tonsils, for it has been shown by Walsham and others that the tonsils are frequently affected with tuberculosis.

Creeping on the ordinary floor or carpet has been considered by Volland and others to be a not infrequent cause of the infection. Tubercle bacilli may in one way or another become scattered on the floor, as in a dirty tenement inhabited by a tuberculous individual, and the creeping child may smear its fingers with the infected dust and dirt, and then, as children so constantly do, put them into its mouth. If the child is permitted to creep at all, a clean sheet or "baby's creeping cloth" should be spread on the floor for this purpose. Dieudonne[1] examined the dirt on the hands and the secretions in the nose of a number of children of ages from nine months to three and one-half years, and almost invariably found tubercle bacilli in the dirt as well as in the secretions. With cultures of these bacilli as well as the original secretions, he inoculated a series of guinea-pigs, who became infected and exhibited all the classic signs of tuberculosis. He concludes from these investigations that the great frequency of tuberculosis in children is largely due to the fact that parents in general, and especially of the poorer classes, allow their children to crawl about the floor.

During the school period the ventilation and light entrances into the schoolroom must be known to be adequate, and care must be exercised not to overburden the child by too long hours. The daily medical inspection of schools now in vogue in many cities is a valuable safeguard, although perhaps tuberculous children are liable to escape notice in a transitory visit. Fortunately, however, for its neighbors, at least, a child does not expectorate to any considerable extent. For schoolchildren suffering from incipient or latent tuberculosis without cough, or at least without expectoration, the open-air school is now available in

[1] Referred to in the British Medical Journal, Sept. 26, 1903.

some cities, and has been found to be an invaluable means of restoring the child's health while it is continuing its education. (See Fig. 20.)

When the age of puberty arrives, particular care should be exercised in the prevention of overexcitement or overwork, for this is a susceptible period.

In the choice of an occupation preference should be given to an outdoor one, and one which does not require excessive devotion of mind and body. In general, country life is preferable to a city one. The character of an occupation is a matter of importance in prevention. Certain callings are conducive to lowered vitality or are directly irritative to the pulmonary tissues. Such are the dusty trades, like those of cigar-making, rag-sorting, grinding, stone-cutting, steel-polishing, etc. Often it is not so much the occupation *per se* as the unhygienic conditions under which it is pursued. Workshops, factories, stores, and the notorious sweatshops are often badly or not at all ventilated and insufficiently lighted. Further, these unfavorable conditions of the workshop are supplemented, not infrequently, by the unhygienic ones of the home. Tenement-house existence is generally unwholesome, and the crowded condition prevailing maintains the air in a constant state of impurity. Insufficient food and imperfectly prepared and the abuse of alcohol are further causes of a depressed condition.

General Prophylaxis.—We have under this head to consider the disinfection of contaminated houses, the prohibition of promiscuous spitting, the protection of the milk and food supply, the removal of dangerous consumptives to a hospital or asylum, factory and school inspection, the supervision of injurious occupations or trades, and other general sanitary regulations.

When a room has been occupied by a consumptive, however mindful he may have been in caring for his sputum, it should be thoroughly disinfected and renovated. In most cities and many health resorts the city or local boards of health perform the disinfection, and the usual methods in vogue are those used for other infectious diseases—fumigation by formaldehyd gas; but this alone is not enough with the tuberculosis infection, in the writer's opinion, and it is well to bear in mind that formaldehyd gas will not disinfect unless the atmosphere of the room contains a certain amount of moisture—65 or 70 per cent. Any form of gaseous disinfection is only superficial and does not penetrate to any great degree. Therefore, in addition to the fumigation there should be renovation and destruction. The walls, floor, and ceiling are to be washed with a solution of corrosive sublimate, 1:1000, or even stronger, or, as recommended by the New York Board of Health, a solution of washing soda in the proportion of $\frac{1}{2}$ pound to 3 gallons of hot water. If there is paper on the wall, it should be removed after the washing. After this the room should be left exposed to the sunshine, light, and outer air for several days, then the walls and ceiling should be repapered, kalsomined or white-washed, or it would be better to paint the walls. The bedding, carpets, rugs, etc., should be submitted to steam disinfection, and all personal clothing, small articles, like books, cards, paper,

Fig. 20.—Open-air school on the roof of a park building.

etc., which may have become hiding places for the bacilli, should be destroyed.

In houses or rooms in a comparatively clean condition, and where the tuberculous individual has properly disposed of his sputum, instead of the chlorinated-lime method of disinfection, that recommended by Esmarch and Coates[1] may be sufficient. The wall-paper is thoroughly rubbed with bread or dough kneaded to a proper consistency. The floors and woodwork are washed with soap and water and the ceiling white-washed. The bedding, clothing, and other similar articles are either treated by steam or washed with boiling water.

In most states and cities there now exist laws against indiscriminate spitting in public places, conveyances, and on the sidewalks. The detection and punishment of infractions of this prohibition are obviously difficult, still the moral effect of the existence of such a law and the attention which it calls to the danger of the habit of spitting are of great value. No part of the prophylaxis of tuberculosis is more important than the restriction of this uncleanly and pernicious habit, for it is obvious that

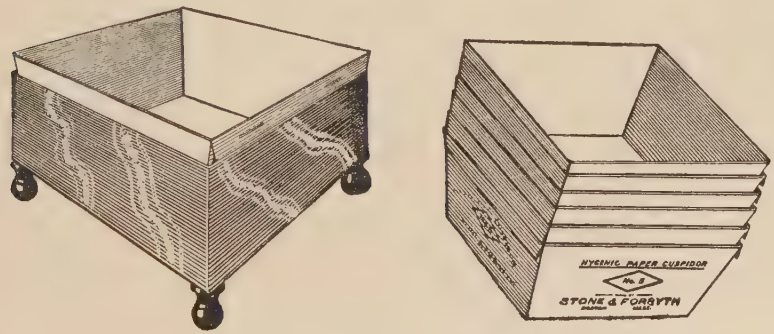


Fig. 21.—The hygienic cuspidor.

among the promiscuous spitters a certain proportion of them are tuberculous. In the writer's opinion, cuspidors should be placed in liberal quantities in public places and conveyances, and carefully cleaned once or twice a day. "No house should lack them," says Cornet; "neither the palace nor the hovel." They should be in a conspicuous position in public places and labeled, "Spit here and nowhere else." The "hygienic paper cuspidor" is cheap and satisfactory for this purpose and can be burned after use (Fig. 21).

In the northern latitudes, during the colder months of the year, a large proportion of the people suffer from so-called catarrhs, necessitating frequent clearing of the upper respiratory passages, and the natural and only means of doing this is through the medium of the saliva, which must then be ejected. Hence the importance of providing a safe and cleanly means for so doing.

[1] British Congress on Tuberculosis, Transactions, 1901, vol. ii, p. 100.

The supervision of the source of the milk-supply of cities and towns is now recognized by most sanitary authorities as an important part of their functions. Not all households will take the trouble to boil milk from unknown sources, and hence the extreme value of safeguarding the milk as it enters the city by requiring evidence that the cows of the dairies supplying milk have been tested periodically and found to be free from tuberculosis. The danger from milk may be comparatively slight, as the Koch school think, but so long as at least the possibility of danger exists, it must be avoided by effective milk and dairy inspection. The resolution adopted by the late International Congress on Tuberculosis at Washington upon bovine tuberculosis is conservative and wise: "Further preventive measures," it says, "must be continued against bovine tuberculosis, and the possibility of the propagation of this to man should be recognized."

The danger from tuberculous meat and other dairy products is, in the writer's opinion, comparatively small.

There is no greater source of infection than a helpless consumptive in a crowded tenement, too ignorant or helpless to properly dispose of his sputum, and infecting his abode and family. For such cases the public should provide adequate hospital accommodations, and the local board of health should promptly remove such patients to the hospital for the protection of the other members of the family and the public. As yet, in most states and cities, very inadequate facilities exist for isolating helpless and dangerous consumptives, but the need is now generally recognized, and is leading to the establishment of consumptive hospitals.

No means of prevention will so effectively or steadily diminish the prevalence of pulmonary tuberculosis as the isolation of advanced cases in consumptive hospitals. Newsholme[1] has conclusively shown that in England and Wales a large and continuously increasing amount of institutional segregation of phthisis has been accompanied for nearly forty years by a large and continuous decrease of the disease, and throughout the entire period each of these changes has gone on at much the same rate as the other.

The inspection of workshops and factories is now a part of the sanitary code of many cities, and this inspection should include some sort of medical examination of the operatives who show suspicious symptoms of tuberculosis. In Germany, every working man or woman found to be suffering from the disease is immediately sent to one of the sanatoria maintained by the state insurance societies, in which all working persons are obliged to be insured against disease. In the great chocolate establishment of J. S. Fry & Sons of Bristol, England, where 2000 women and girls are employed, every applicant for employment is examined as for life insurance, particular attention being paid to the lungs and heart.[2]

In schools, pupils showing suspicious signs of tuberculosis should

[1] The Prevention of Tuberculosis, 1908.

[2] The Segregation of Tuberculous Patients Among Factory Workers, C. W. J. Brasher, L.R.C.P., M.R.C.S., Bristol, British Medical Journal, Aug. 27, 1904, p. 442.

be removed, and in the daily medical inspection now in practice in a large number of city schools the teacher should be urged to point out pupils showing any evident symptoms of a possible tuberculous infection.

Where the so-called dangerous trades are carried on, special precautions in the way of respirators or guards to the nose and mouth or other appliances should be required, and other methods of disposing of the dust, in order that that particular occupation should be rendered as little dangerous as possible. In many cases the operatives are quite as much, or more, at fault than the employers in maintaining unhygienic conditions, and exposing themselves and others to sources of infection. They must be enlightened by simple talks on health, and especially on the prevention of pulmonary tuberculosis, as is now frequently done at the meetings and clubs of the various labor unions. All effort in improving the living conditions of the masses is directly conducive to the prevention of tuberculosis, as is shown by the great diminution of this disease within the last twenty-five or thirty years, and before the infectious nature of the disease was known and before special prophylactic measures were instituted against it.

Associations for the study, relief, and prevention of tuberculosis now exist in most countries and are rapidly being formed in this country. They are means of great value in the tuberculosis crusade. Through literature, lectures, and tuberculosis exhibitions they enlighten the people regarding the disease; through visitors and nurses they find out the wants and condition of poor consumptives and render aid in the way of relief and control; through agitation they are arousing the public to demand of the state or city adequate accommodations for poor consumptives; and in many other ways are doing most efficient work in the warfare against tuberculosis. The modern free tuberculosis dispensary, with its visiting nurses, is another most valuable means of prevention. The consumptive person is not only kept under supervision, but his home and family as well, by the visiting nurse. The supervision and protection of the members of the patient's family are, from the standpoint of prevention, more important than the care of the consumptive himself.

The following circular, issued by the Imperial Board of Health of Germany, is so admirable in clearness and simplicity of statement that it is reproduced here as useful for educational purposes in prophylaxis:

HOW DOES ONE PROTECT ONE'S SELF AGAINST TUBERCULOSIS?

In the case of no common disease is it so much in the power of each person, of even the weakest and poorest, to help himself as in that of tuberculosis, if he only combines insight with self-control.

I. MEASURES AGAINST CONTRACTING TUBERCULOSIS

1. Let every person, whether well or sick, provide for the safe removal of the sputum, since one cannot detect whether sputum is tuberculous or not. **Do not spit on the floor of closed rooms**

(including street-cars and railway-coaches) or on frequented thoroughfares. **Place in convenient corners spittoons filled with water,** which, to insure safety, should be cleansed at short intervals (best by boiling out). Hold your hand (or a cloth) before your mouth when coughing. Turn away from a coughing neighbor. Articles of clothing should always be kept clean; the trailing of garments should not be tolerated. The clothes, beds, linen of tuberculous persons may be used by others only after thorough disinfection. Dry sweeping should give place to moist; if need be, scour with hot soda or a hot solution of soft soap. The raising of dust in the home, the work-place, and on the street should be avoided whenever possible. Shun places of refreshment where spitting on the floor is allowed.

2. **Let the strictest cleanliness prevail in the preparation and preserving** (guard against flies) as well as **the eating of food,** especially of that which is eaten raw. **Milk** (from unknown sources) **should be boiled and meat cooked thoroughly before being eaten;** the boiled milk should be covered and kept as cool as possible.

3. **The hands, including the nails, the teeth, and mouth should be cleansed frequently and thoroughly. Putting the fingers into the mouth or nose and also scratching the face should be discontinued. Every sore** should be protected against impurities by suitable bandages.

II. MEASURES FOR STRENGTHENING THE BODY

It is impossible to extirpate all tubercle bacilli, therefore it is indispensable so to strengthen and harden the body that the absorbed germs cannot take hold upon it. The principal means are:

Plain and wholesome food, which, by judicious selection, need not be expensive. Dainties and intoxicating drinks should be avoided.

A dwelling accessible to the entrance of air and light; rather in the suburbs than in the heart of the city; **the best room selected as a sleeping-room.**

Plain, durable clothing, out of material not too thickly woven, neither too warm nor too cool; in the case of a person in repose or of a sedentary occupation, warmer than in that of some one frequently in motion; discarding the follies of fashion that hamper the free movement of the body—*e. g.*, the corset and belts.

Only after defraying the costs of these unavoidable necessaries may other expenses be considered.

Let order and cleanliness have the first place in the whole conduct of life. Wash the whole body daily with moderately cold water or rub it vigorously with a rough, damp cloth, bathe in pure river or sea-water, or take a shower-bath (sparing the head), keep hair and beard, teeth and mouth, also the nails, clean. **Breathe through the nose, keeping the mouth shut;** the former is the natural filter for impure and injurious substances. If breathing through the nose is difficult, be examined by a physician; the impediment is often easy to remove.

Devote your whole strength to your work; it gives strength in return; seek, however, to perform it in accordance with the rules of health, so far as these can be reconciled to it. Take advantage of prescribed measures for protection. Avoid a bent position in intellectual work. If you are an employer, consider how you may remove noxious substances or prevent such from arising (dust, smoke, etc.). The time for work and rest should be in proper proportion.

Devote the hours free from work to the strengthening of those parts of the body that had little opportunity to be exercised during work. Take exercise outside of your dwelling. Draw in long, deep drafts of fresh air while holding the hands pressed tightly against the sides. Accustom yourself also to being in the open air in unfavorable weather. Change wet clothing and shoes. Gymnastic exercises—especially when out-of-doors—suited to the conditions of the body, together with tramps on foot, games, moderate cycling, rowing, swimming, and the like, are the best allies in the fight with tuberculosis.

Go to bed at a reasonable hour. Avoid excesses of every sort. They destroy in a few minutes what has been gained in years.

Finally, shun intercourse with persons who are suffering from infectious diseases; if duty or vocation demands such intercourse, then bear constantly in mind the prescribed measures of precaution. If you move into a house in which a tuberculous person has recently lived, have it first disinfected.

THE GENERAL MANAGEMENT OF THE TUBERCULOUS INDIVIDUAL (PULMONARY)

At the outset, certain general facts must be clearly recognized as governing principles in the management of this disease:

First, that there is no specific remedy for tuberculosis as yet known.

Second, that there is no antiseptic which will materially influence the local infection.

Third, that the whole treatment is in a sense an indirect one—a treatment of the individual and not of the disease.

His vital powers must be so increased that his body will become rebellious to the bacterial invasion. An acquired immunity or resistance must be established.

The battle is with the individual and not with the disease; consequently the treatment must be a strenuous and exacting one, both on the part of the physician and the patient. In most cases also it is a long one.

"Benefit," says Osler, "is usually a matter of months; complete arrest, a matter of years; absolute cure, a matter of *many* years."

Furthermore, the earlier the disease is discovered and treatment begun the better will be the prospect of recovery, for the less will be the impression made upon the general health by the tuberculous infection.

Whatever, then, conduces to the improvement of the constitutional condition must be made use of in the treatment, and whatever un-

favorable or vicious conditions are present in the life and environment of the individual must be eliminated.

In the accomplishment of this task we learn from nature. It is the *vis medicatrix naturæ* which is our handmaid in the struggle. Pure air, food, and rest are our dependence, and success in treatment comes from our skill and persistence in their use. Whatever drugs or medicines we may employ are only minor helps, and the more care and perseverance we exercise in the application of these great natural resources the less use we shall have for medicine.

"No single element," says Cornet, "neither air, food, hydrotherapy, nor medicine, promises us any assurance of success. Only the combined fulfilment of all the physiologic and hygienic conditions of life to the smallest detail gives us a prospect of success. The physician will only then accomplish good results when he ever keeps this fact in mind."

This natural treatment of tuberculosis, as it may be called, is known as the "open-air" or the "hygienic-dietetic treatment." It consists essentially in the constant and continuous exposure of the patient to pure outdoor air, including sunshine, the patient being at rest, or under certain guarded conditions, and at certain stages of the treatment allowed to take exercise; and an abundance of nourishment, carefully arranged as to quantity, quality, and the assimilative powers of the patient; in hydrotherapeutics, applied according to the general condition of the patient and the activity of the disease; and in tranquillity and hopefulness of mind. All this is to be most carefully arranged and constantly supervised by the physician, who must in the most painstaking manner personally see that every detail is fulfilled. In order to secure the coöperation of the patient he must be *truthfully* told of his condition and its dangers, as well as the hopeful outlook from treatment if he implicitly obeys his physician.

The personality of the physician counts for more in the treatment of this disease than perhaps in almost any other, and, in the writer's opinion, the brilliant successes obtained at the sanatoria of Falkenstein and Nordrach, for example, are due quite as much to the personality of Dettweiler and Walther, their directing physicians, as to the treatment.

Firmness, tact, kindness, patience, insistence, and cheerfulness are qualities of supreme importance in the physician who will treat pulmonary tuberculusis with the highest measure of success.

Again, success in treatment depends largely upon the accurate and thorough examination of the patient and his local condition, and nothing relating to his general state or the disease is too insignificant to be disregarded. The case, as a whole, is to be so thoroughly studied and analyzed that the physician shall have a perfect conception of the problem presented to him. Then will he be in a position to attempt its solution. He will determine upon what points to lay especial emphasis in his treatment, and will be guided in the special application of the means at his command by the result of the searching investigation of the individual patient.

No manual of treatment can do more than to present, with as much

perspicuity as possible, the general methods of modern treatment, and the physician alone is in a position to apply them to the individual case before him.

The surgeon is furnished with the instruments proper for a certain operation; he is instructed in their use, but the results obtained with them will depend upon his skill in their application and his knowledge of the case and its requirements.

In a general way, cases of pulmonary tuberculosis may be divided, with reference to treatment, into two great classes: First, those which offer favorable conditions for an arrest or cure; and, second, those which, from their advanced stage or the intensity of the infection and absence of resisting power, appear to be hopeless so far as any permanent improvement is concerned. It is not, however, possible or safe to make this distinction too sharp, for any case in its course may change from one division to the other.

The writer has always remembered the response made to him by Walther, of Nordrach, when asked if he received only incipient cases. "I take," he replied, "all kinds of cases, for I never can tell beforehand which will do well and which will not." Loomis, in examining patients for the Adirondack Sanatorium at Saranac, says that 27 per cent. of the cases which he considered unfavorable ones were discharged apparently cured, and 20 per cent. of cases which he regarded as favorable failed to make a recovery or remained stationary. But this does not mean, however, that all cases should be treated alike. Each must be individualized. In general, those in the latter division are amenable only to palliative treatment. If, however, a favorable moment should occur—a period of quiescence, a reassertion of the recuperative powers—the physician should stand ready to take advantage of it in the application of more positive measures; and, again, in a palliative plan of treatment, the physician should refrain as far as possible from doing harm to the natural forces of resistance and repair—the appetite, digestion, assimilation, excretion, and arterialization—by the use of drugs for the temporary relief of symptoms, such, for example, as opium for cough.

Nutrition should never be sacrificed for comfort, unless the discomfort is so great that it in itself interferes with nutrition.

It is the first division, in which the cases offer a reasonable prospect of arrest, to which is applied the hygienic-dietetic treatment in its completeness, either in a sanatorium, in an open health resort, or at home, and again the importance of an early diagnosis may here be emphasized, for even if a positive diagnosis cannot be made, but if all the evidence points to tuberculosis, the case should be considered such, and treatment instituted.

The patient must first of all change his environment and habits; not always go away from home, but change his conditions of living; not necessarily in every case abandon his occupation even, although generally this will be advisable and the safest plan to pursue, for the disease is a serious one, and in the vast majority of cases one's entire time and efforts are demanded in getting well.

Later on in the treatment, if all progresses favorably, a certain amount of outdoor work may be undertaken, with the approval and supervision of the physician in charge.

Tuberculosis is a house, an indoor, disease, as Flick has so often and insistently declared, and whether the treatment is undertaken at home or abroad, the indoor life must be changed to an outdoor one, and the practical question at once arises, How and where is this to be accomplished? In answering this question, we must consider the individual, his disease, and his social and pecuniary condition. The majority of cases must be treated at home, if treated at all. Some, however, are in a position to make a change of climate, or removal from their home to a sanatorium, or an "open resort" in essentially the same climate as at home, but in a locality where pure air can be obtained.

We have then the one class, the poor consumptive whose conditions are fixed, who can make no radical change, and in treating him we can only make the best of such limited opportunities as are afforded. But, fortunately for many of this class, the state sanatoria now springing up throughout the country offer a means of escape from the unfavorable environment of the tenement house and its conditions. Moreover, as will be later on discussed, much can be done with the means now at our command for this class, even under the unfavorable hygienic conditions in which they live. The tuberculosis dispensaries, tuberculosis classes, and day camps have accomplished very much for this class.

The second class, unfortunately the smaller, can go where we wish and do what we advise. Whether or not a radical change of climate is considered the best method of applying the open-air treatment in any individual case, we must in all cases, unless, as has just been mentioned with the first class, inexorable conditions preclude any change, place the patient where he will obtain pure air, and where he can constantly enjoy this pure air. All authorities agree that the first and principal requisite of any climate in the treatment of tuberculosis is the facility which it affords for leading an open-air life in a pure atmosphere. This does not mean fine weather always, or the presence necessarily of any one of many other favorable climatic elements, such as dryness, warmth, attenuation of air, equability, etc., as valuable aids as some or all of these may be. The open-air life is possible and successful, as abundant experience has proved in what we may term very indifferent climates, where the variations of temperatures are frequent and great, where the atmosphere is moist, storms, rain, and fog not infrequent, the winter cold severe, and the sunshine not overabundant. It is not contended that such climates are ideal, and that the regions with more favorable climatic characteristics do not possess appreciable advantages, but they *do* fulfil the principal indication—namely, pure air.

The excellent success obtained in sanatoria situated in indifferent climates, as at Nordrach in the Black Forrest, Falkenstein and Goerbersdorf in Germany, Saranac in the Adirondacks, Sharon near Boston, Liberty, New York, Rutland in Massachusetts, and in numerous others where the climate is cold and changeable the greater part of the year,

attest the truth of this fundamental principle, that pure air is the first and chief requisite, and pure air, preferably in a cool, invigorating climate, for it has been found that patients make more rapid progress during the cold weather. The winter is the season when the treatment shows the best results.

Nine-tenths of all consumptives have lived an indoor life, and the radical change to the outdoor life is almost appalling to them. It requires persistent and vigorous effort to keep them up to it. They are so apprehensive of taking cold; they fear that they have not sufficient strength to endure the exposure, and sometimes, unfortunately, the physician is influenced by these fears. When once, however, the outdoor habit is acquired, enthusiasm takes the place of fear. The sense of well-being caused by the stimulating effect of the constant hyperaëration is so keen, and the evidence of its beneficial effects in the amelioration of the cough, the subsidence of expectoration and fever, and the improvement of the appetite is so apparent that the patient is not deterred from taking his "cure" in all sorts of weather.

"In spite of rain, fog, wind, or snow," says Dettweiler, "in spite of a temperature below zero, very often without sun, the patients spend from seven to ten hours out-of-doors and sometimes even eleven hours."

With most patients the change must be somewhat gradual. Confidence in this treatment must be established and fear of evil consequences dispelled. As soon as possible, however, the whole twenty-four hours must be passed in fresh air. This invariable rule must be, outdoors all day and with windows wide open at night, or in many cases sleeping out-of-doors, either on a piazza or in a shack or sleeping-porch, entirely exposed in front to the open air. With a hot-water bottle or soapstone at the feet, a hood for the head, and an abundance of bedclothes, the patient can be made comfortable even in the winter weather of northern latitudes, and sleep peacefully even in a snow-storm (Fig. 22). Outdoor sleeping has now become so popular that it is not only the usual method with the consumptive, but is often adopted as well by those in health.

During the winter of 1903–04, 50 per cent. of the patients at the Adirondack Cottage Sanatorium slept out-of-doors, not only without injury, but with apparent benefit, though it was one of the coldest winters known there for many years.

At the Rutland sanatorium every patient subscribes on entrance to the following:

First: Patients must spend at least eight hours out-of-doors daily unless excused by the physician.

Second: Food should be taken as a duty, even when there is no desire to eat.

Third: All windows are to be opened and closed by the nurse or attendant only.

It has been found that complete rest for two or three weeks at least on beginning the treatment is advisable, even if there is no rise of temperature, this rest to be taken in the semirecumbent position in a so-

called "reclining chair." If there is *temperature*, at whatever period of the treatment, absolute rest should be enforced, unless a little walk during the morning remission is allowed under special circumstances, but only on condition that the afternoon rise is not increased.

Dettweiler's practice at Falkenstein was to keep all his patients practically at rest most of the time—"the open-air rest cure," as it was called. Trudeau, of Saranac, also favors this practice, for he considers that absolute rest, so long as it is taken in the open air, is the best measure at our command to reduce the pyrexia of tuberculosis, to conserve the patient's energies, to abort the activity of the process, and to encourage the formation of fibrous tissue about it. "The objection," he says, "that a patient cannot digest if he cannot exercise does not seem generally to be supported by experience, as most of the patients while living out-of-doors, and keeping absolutely at rest, eat and digest an amount of food that would suffice for laboring men."[1]

Nahm, chief physician of the Ruppertshain Sanatorium, gives the following minimum and maximum time for the rest cure ("Liegekur"):

Minimum		*Maximum*	
8 to 9	o'clock A. M.	8 to 10	o'clock A. M.
12 to 1	" P. M.	10.30 to 1	" A. M.
2 to 4	" P. M.	2 to 4	" P. M.
6 to 7	" P. M.	4.30 to 7	" P. M.
8 to 9	" P. M.	8 to 9	" P. M.
Total, six hours.		Total, ten hours.	

The question of exercise in the course of treatment is one of vital importance, and the physician should have clear ideas regarding it. Only general principles, however. can here be laid down, and the individual application must be made after long and careful observation of the patient. This subject will be considered more in detail later.

DETAIL OF THE OPEN-AIR LIFE

In a sanatorium facilities for living out-of-doors are part of the equipment, either in the form of open air galleries or especial structures, called by the Germans "Liege-halle," or lying halls, which consist of one-story barracks or sheds open on the side toward the south, and protected on the others and overhead, or in this country by means of the popular "lean-to" devised by Dr. King, of the Loomis sanatorium. An open piazza, extending along the southern side of the main building, is also applicable for this purpose, or a veranda opening out of the sleeping room, so that the bed can be rolled out upon it, if the patient is confined to his bed or sleeps out-of-doors (Figs. 22, 23, 24, 25, 26, 27, 28). Instead of a permanent roof to the veranda, it is preferable to have a movable awning overhead, so that the light and sunshine may not be shut off from the bedroom.

Innumerable structures have been devised for outdoor life by day

[1] The Sanitorium Treatment of Incipient Pulmonary Tuberculosis and its Results, by E. L. Trudeau, M. D., Medical News, June 2, 1900.

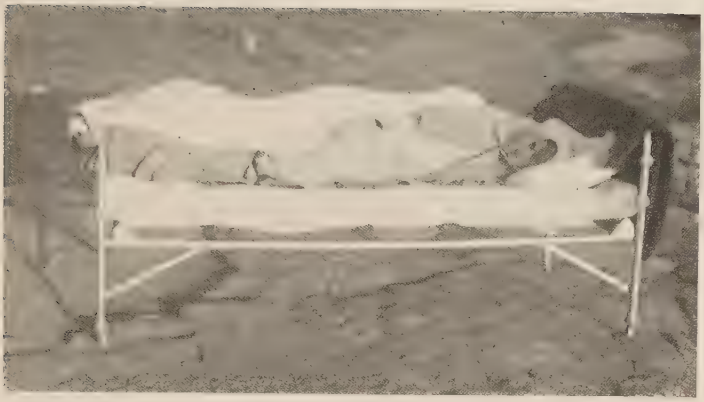


Fig. 22.—Method of wrapping up when sleeping out of doors.

A B

Fig. 23.—Sleeping porches: A, an out-door sleeping porch; B, a typical Colorado sleeping balcony for patients. (From Trudeau in "Outdoor Life.")

Fig. 24.—Balcony. (From Burton-Fanning.)

Fig. 25.—Second-story porch for out-door life. (From "Outdoor Life," Trudeau's article.)

Fig. 26.—Inexpensive sleeping balcony in a country house.

Fig. 27.—Open-air treatment at Louise Childs Memorial Cottage at Saranac. (Adirondack Cottage Sanatorium.)

Fig. 28.—Open-air treatment at one of the Massachusetts State Consumptive Hospitals.

and outdoor sleeping by night—huts, cabins, barracks, kiosks, shacks, sun-traps, tents, chalets, and "shelters," views of some of which various structures are herewith given, which will indicate better than any description their form and use (Figs. 32–41).

By means of these various structures a practically open-air life is rendered possible. A kiosk, or similar structure, which can be revolved on its axis, so as to follow the sun or avoid the wind, as well as to vary the view, is an attractive and useful method (Fig. 27).

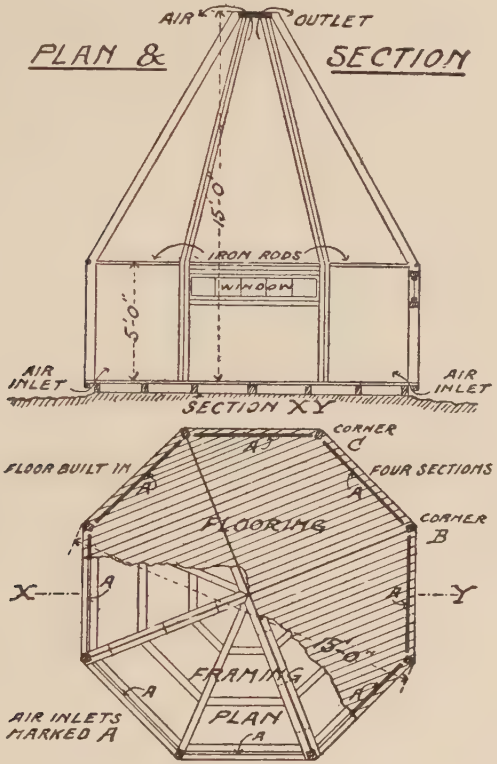


Fig. 29.—The Gardiner sanatory tent.

There are various tents which have been especially devised for the consumptive, with especial methods of securing adequate ventilation and constant circulation of air, such are those of Professor Fisher, of New Haven (Fig. 43); the "sanatory tent" of Dr. C. F. Gardiner, of Colorado Springs (Fig. 29); of Holmes, of Denver, the Nordrach tent (Fig. 30), and the "Ulrich tent" (Figs. 31, 44, 45). The ordinary common tent is not to be advised, for it affords no adequate ventilation; it is difficult to obtain the maximum amount of sunlight, and it is likely to be hot in summer and cold in winter. If a tent is used, it should have ample means of ventilation, like some of those mentioned above. It should

have a wooden floor, and, if in a cold climate, it must be heated by a stove at the time of dressing and undressing, unless the patient can

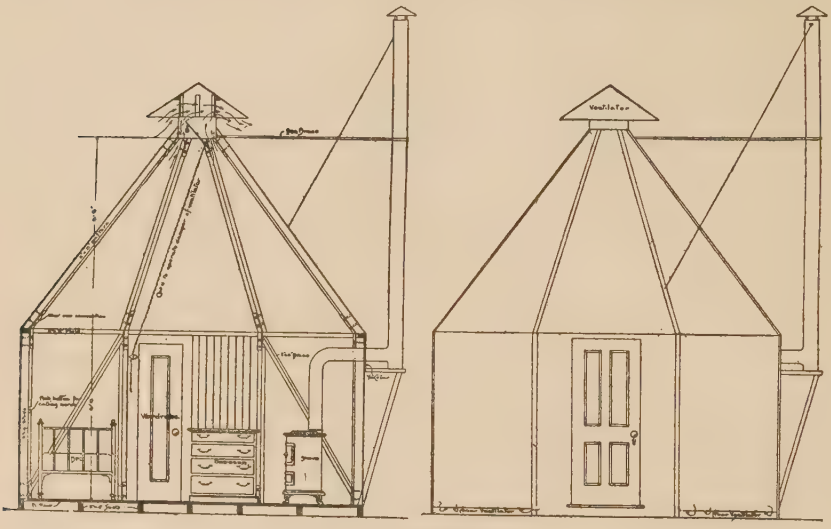


Fig. 30.—Nordrach tent.

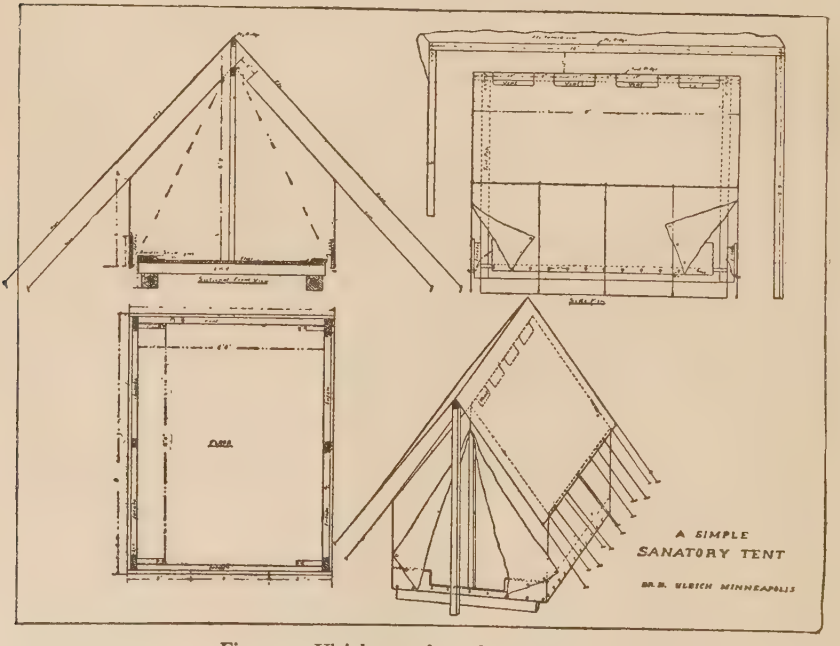


Fig. 31.—Ulrich tent for tuberculous patients.

readily do this in an adjacent house. Shacks or similar structures, however, are preferable to tents.

Fig. 32.—Hut at Dr. Peter's colony near Providence, Rhode Island.

Fig. 33.—The Millet Sanatorium at East Bridgewater. Shack used for treatment of tuberculosis.

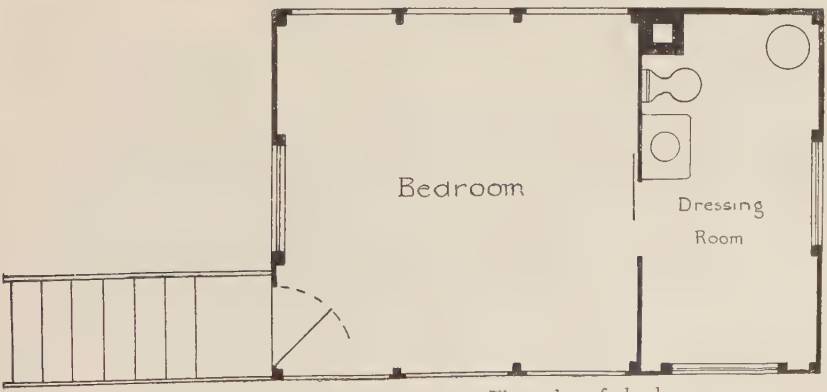


Fig. 34.—The Millet Sanatorium. Floor plan of shack.

Fig. 35.—Sun trap. Victoria Hospital for Consumption, Edinburgh. (From "Life in An Open-air Sanatorium," by Reinhardt.)

Fig. 36.—Dr. Lahmann's Sanatorium. Sleeping box. (From "Sanatoria for Consumptives," F. R. Walters, M. D.)

Fig. 37.—Cottage tent, Muskoka Cottage Sanatorium, Ontario, Canada.

Fig. 38.—The Tucker tent.

Fig. 39.—A sleeping châlet with verandah, Hailey Sanatorium, Wallingford. (From "Life in an Open-air Sanatorium," by Reinhardt.)

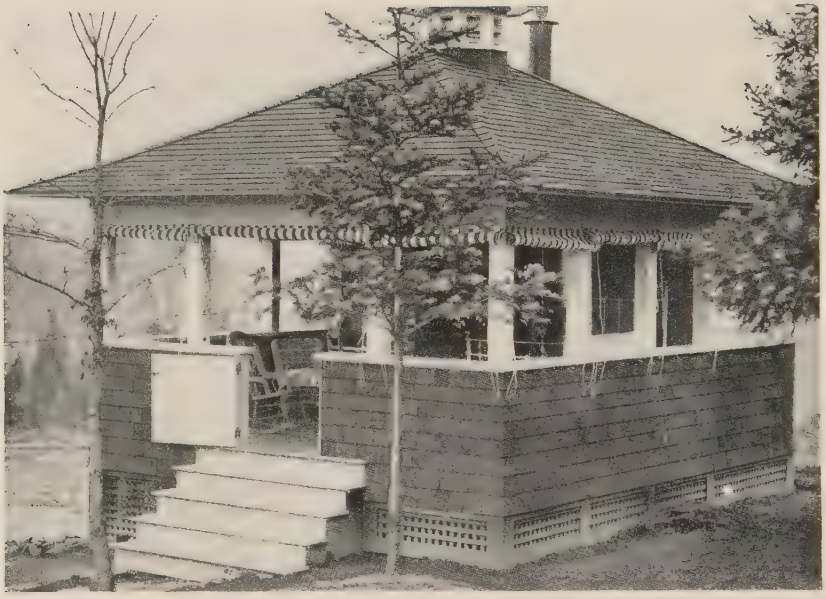


Fig. 40.—Portland, Oregon, Open-air Sanatorium, cost $1000. For one or two patients. (From "Some Plans and Suggestions for Housing Consumptives," published by the National Association for the Study and Prevention of Tuberculosis.)

Fig. 41.—Sleeping shack or "lean-to" at Pembroke, New Hampshire Sanatorium.

Fig. 42.—Revolving shelter. (From Burton-Fanning.)

Fig. 43.—Fisher tent. (From Prof. Fisher of New Haven, Connecticut.)

Fig. 44.—Ulrich tent.

Fig. 45.—Ulrich tent.

During the warm season of the year, or in the warmer latitudes, the open-air treatment can be taken wholly in the open air in a reclining chair or hammock under the trees, with some protection, if desired, for the head from the sun, or in a bath chair with an extension for the feet (Figs. 46). Even in the cold weather it is now the custom to "take the cure" entirely out-of-doors, which can be done without serious discomfort if one is properly clad, and in most modern sanatoria the popular "lean-tos" are used very effectively for this purpose.

It is generally conceded that a recumbent or semirecumbent position is the preferable posture in taking the open-air treatment, and various reclining chairs have been devised for this purpose (Figs. 48–53). The two especially recommended by the writer are the "common-sense re-

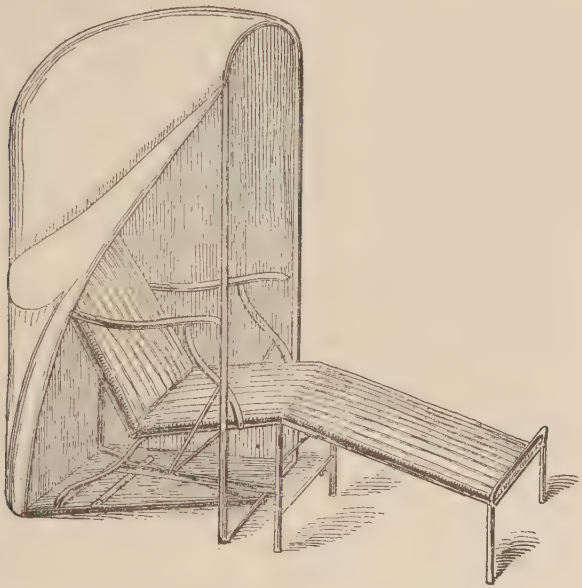


Fig. 46.—Knopf's half-tent with reclining chair.

cliner" (Fig. 50) and Knopf's reclining chair (Fig. 47). Figs. 52 and 53 show reclining chairs as used in German sanatoria.

On pleasant days, whatever the temperature of the air may be, no fixed protecting covering overhead is necessary, and an uncovered piazza or platform, as used at Sharon and Rutland, is to be preferred (Figs. 54, 55). A sun umbrella can be used if the sun's heat is annoying. If it storms, one is not to remain inside, but, of course, is to be protected from the direct effects of the rain or snow by a covered piazza or or awning, or in a cabin or shed open on one side; here, again, the revolving "shelter" is of value.

In the colder months of the year in northern latitudes thick wraps, rugs, fur coats, wool-lined sleeping bags, and horse-blankets are used, and warmth for the feet, such as woolen socks, hot-water bottles, soap-

stone, or an electric-heated coil must be provided. If one sits in an ordinary chair with the feet down, a wooden box to put them in affords considerable protection from the cold (Fig. 56).

The following cuts illustrate the method of wrapping a blanket snugly about one (Figs. 57, 58, 59, 60).

When very cold, the head is protected by a knitted cap or hood, and in sleeping out-of-doors on cold nights a mask over the face can be worn, while fur gloves, a hot-water bottle, or electric heater will keep the hands warm. Thus clothed, like an arctic traveler, even a delicate patient can remain out in winter weather with comparative comfort and experience a lively sense of well-being (Figs. 61 and 62).

In the home treatment of tuberculosis it will often tax the physician's ingenuity to devise methods for the open-air life. If there is a yard about the house, one of the various forms of cabins or shacks can be erected in

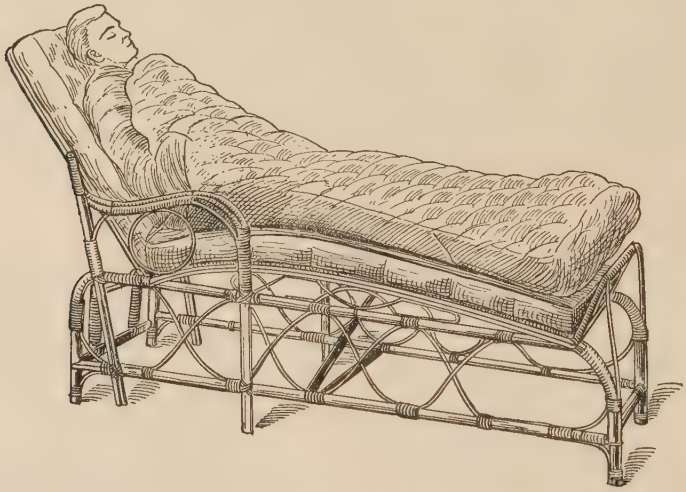


Fig. 47.—Knopf's sanatorium reclining chair with adjustable back.

it, or a platform built out from the house, either from the first or second story (Figs. 63, 64), or a sleeping hut may be erected on the flat roof of a city house (Figs. 65, 66), or a porch, which many houses possess, may be utilized.

If complete outdoor life is impossible, the patient can sit by the open window, where the sun shines by day, and in sleeping use Knopf's ingenious window tent (Fig. 67), or one of the various other similar contrivances for this purpose (Figs. 69–73), or by the use of the Dunham bed, sleep with the head out-of-doors (Fig. 74).

The question naturally arises, What will the patient do with himself all day long and day after day while making the "cure," and especially if he is at rest?

Beside each reclining chair a little table may be placed, and on it some books or games, or material for some sort of hand-work, like

Fig. 48.—"Lying-out cure." System of Weicker.

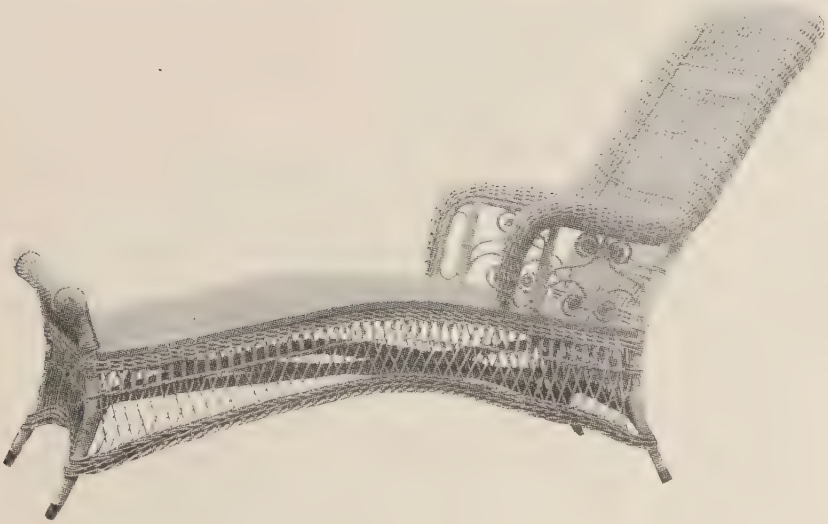
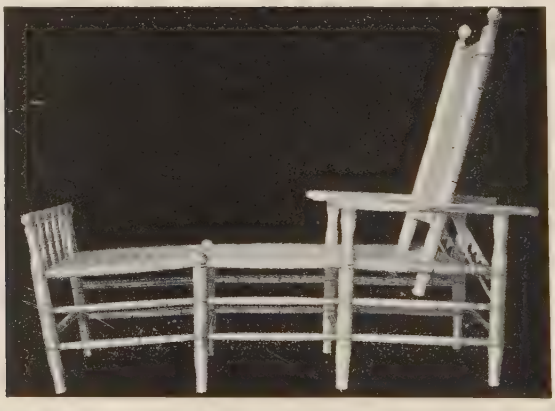


Fig. 49.—Wakefield Company's rattan reclining chair.

Fig. 50.—Common sense recliner. (The Sinclair-Allen Manufacturing Co., Mottville, New York.)



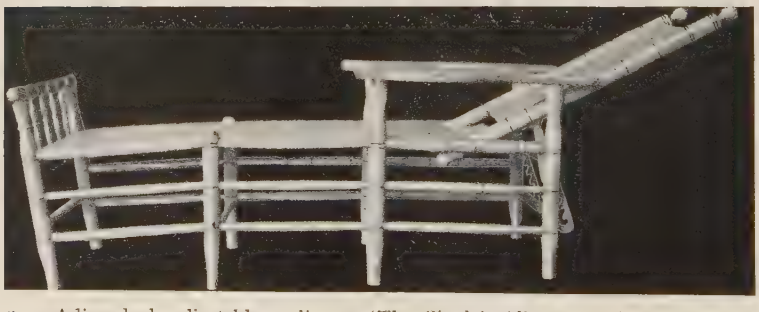


Fig. 51.—Adirondack adjustable recliner. (The Sinclair-Allen Manufacturing Co., Mottville, New York.)

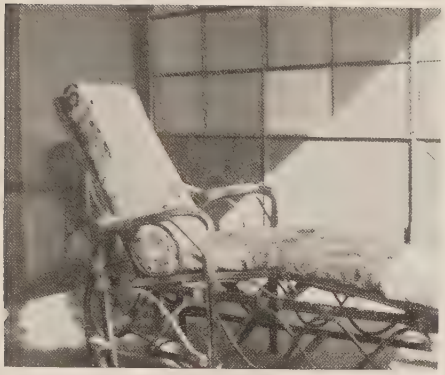


Fig. 52.—Reclining chair as used in German sanatoria.

Fig. 53.—Reclining chairs as used in German sanatoria.

Fig. 54.—The "sun bath" (winter) at Sharon Sanatorium.

Fig. 55.—Wrapped up in winter for open-air treatment.

Fig. 56.—Sitting with feet in box for protection against cold.

Fig. 57.—Method of wrapping blanket about one. (Kindness of Dr. Hills, Superintendent Mass. State Sanatorium, Rutland, Massachusetts.)

Fig. 58.—Method of wrapping blanket about one. (Kindness of Dr. Hills, Superintendent Mass. State Sanatorium, Rutland, Massachusetts.)

Fig. 59.—Method of wrapping blanket about one. (Kindness of Dr. Hills, Superintendent Mass. State Sanatorium, Rutland, Massachusetts.)

Fig. 60.—Method of wrapping blanket about one. (Kindness of Dr. Hills, Superintendent Mass. State Sanatorium, Rutland, Massachusetts.)

Fig. 61.—Visor hood and muffler (Visor Knitting Co.).

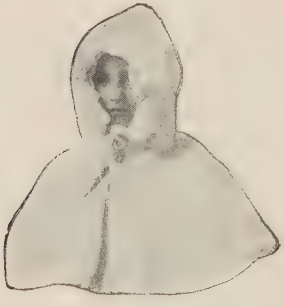


Fig. 62.—The Walsh capote (Cabinet Manufacturing Co.).

Fig. 63.—The Millet original sleeping shack.

Fig. 64.—Porch of house used for sleeping and sitting outdoors.

Fig. 65.—Sleeping tent on roof (case in Boston).

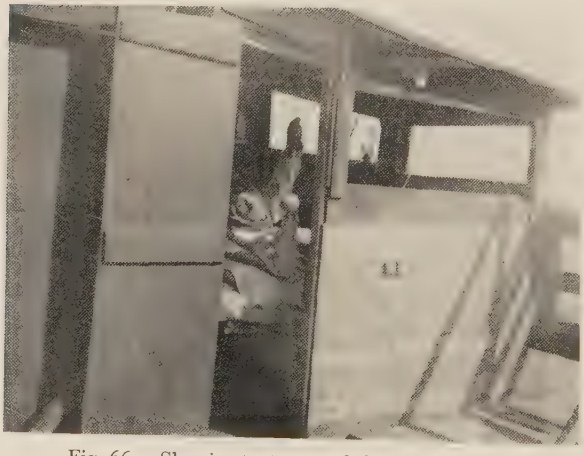


Fig. 66.—Sleeping tent on roof (case in Boston).

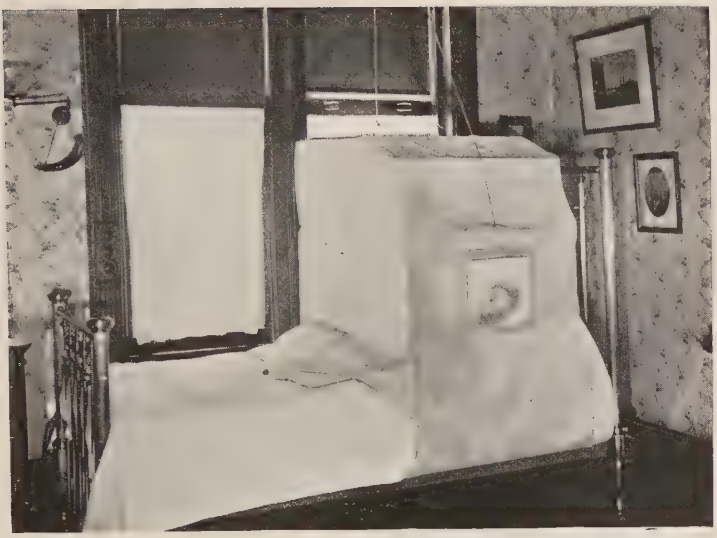
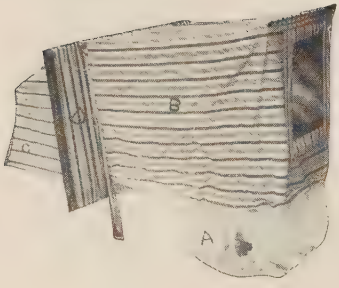


Fig. 67.—Knopf's window tent. Shows the tent in use.

Fig. 68.—Knopf's window tent. Shows the tent out of use.



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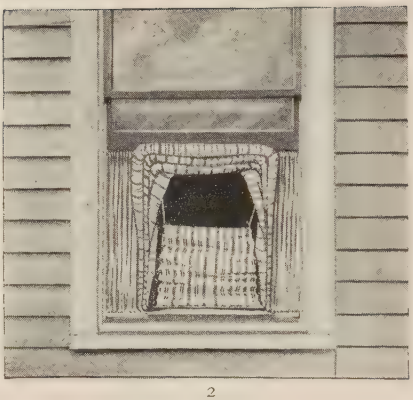

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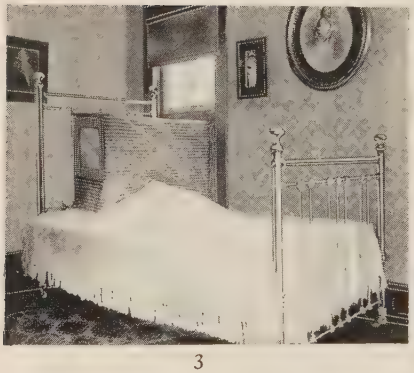

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Fig. 69.—The Walsh window tent (Cabinet Manufacturing Co.): 1. The tent (*B*) comes in over the side of the bed onto the pillow. The patient's head is slipped through the elastic opening shown in the long, loose skirt-shaped bottom (*A*) of muslin or flannel that is laced into the lower edge of the tent (*B*); *C*, outside awning let down to protect from sun, wind, or storm; *D*, adjustable sides which permit tent to fit any window. 2. Tent fitted to window (outside view). Tent in position with awning crushed and wind-break partially raised. 3. Tent in use. Tent over the pillow and patient's head, after the belt has been released. 4. Tent out of use. Tent folded, in the window, held up by the belt.

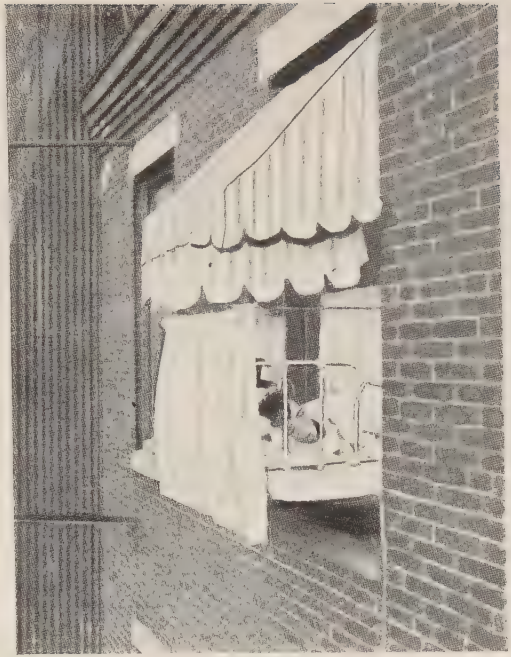

Fig. 70.—Stein's window adjustable and extension bed. Head of the bed out of the window and awning and curtain in position.

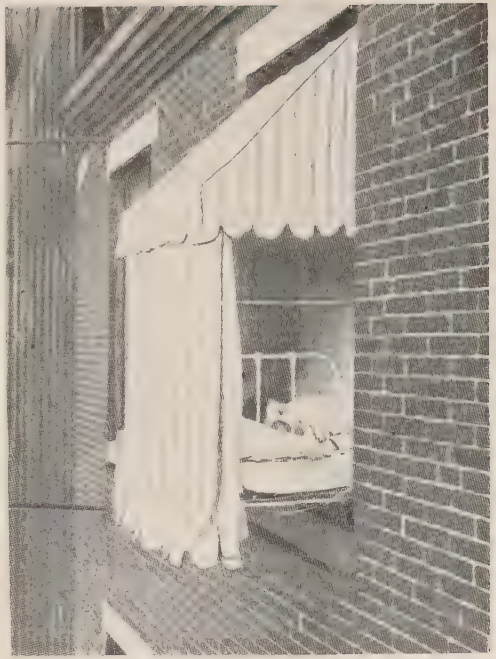

Fig. 71.—Stein's window adjustable and extension bed. Awning lowered to protect patient from rain and wind; curtain arranged so as to have any side exposed or protected.

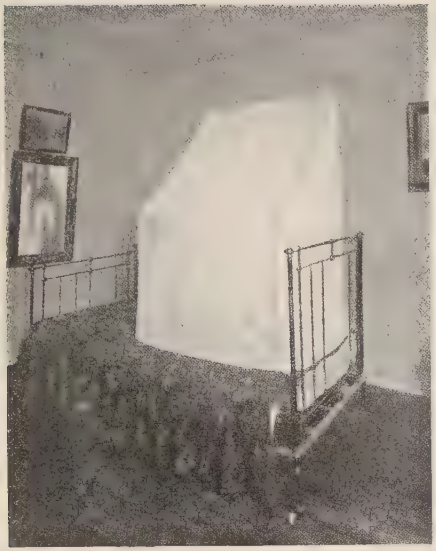

Fig. 72.—Berkeley window tent.

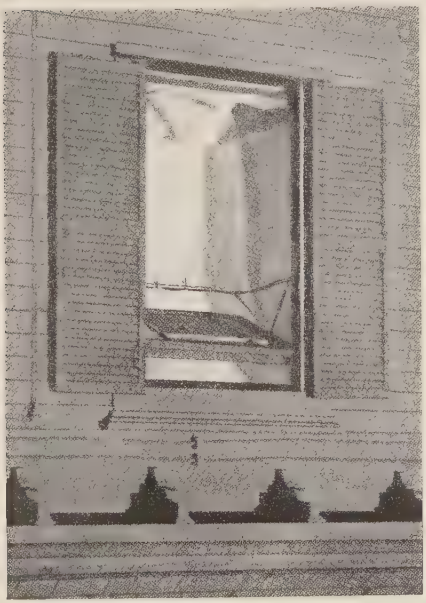

Fig. 73.—Berkeley window tent.

on, and the patient then hurries to a warm room to take his bath and dress.

The effect of all this open-air life is striking. The cough and fever decrease, the appetite and digestion are stimulated, weight is gained, sleep is sounder and more refreshing, nervous irritability disappears, returning vigor is felt, and the patient experiences a delightful sense of well-being and renewed life.

"No one," writes Daremburg,[1] who was himself a consumptive, "knows the happiness of a consumptive who quits his tainted chamber to live 'au grande air' if he has not himself experienced the benefit of this change."

THE FEEDING OF THE PATIENT

"Proper nourishment is the foundation and corner tone of the treatment of consumption," says Dettweiler. No change of climate, not the most faithful adherence to the open-air life, will bring success in the treatment unless the nourishment of the patient is such that the past loss may be made up and the body weight increased, and by an increase of body weight is not meant rapid accumulation of flabby fat, which may be more of a menace than a real improvement, but a gradual, regular gain of good firm flesh, and to determine this the patient should be weighed every week. In general, a liberal amount of nutritious food, as much or more than an ordinary healthy individual would eat, must be taken. The occasions for excessive overfeeding, the so-called "forced feeding" of Debove, are exceptional, and involve the risk of entirely upsetting the digestion, but there are times when the existing conditions and the future prospect justifies the risk.

Goodbody, Bardswell, and Chapman[2] have studied the effects of forced feeding upon cases of pulmonary tuberculosis in comparison with normal individuals, and have found that, although the amount of food produced ill results upon normal persons, it may be ingested by consumptives with impunity; yet very large diets gave worse results than those of more moderate amount. The condition which warrants a trial of overfeeding is a weight much below the normal, accompanied with active lesions. When this crisis is past, if it is, a return to a more moderate diet should be made.

The experiments of Professor Chittenden, of New Haven, made upon athletes, soldiers, and professional men, and extending over a series of months, would seem to show that the previously accepted average diet for a normal individual is much above the actual physiologic needs, and by a very considerable reduction of this average diet he found the weight was not decreased and no loss of strength was incurred. This may be a hint to us in the feeding of consumptives. To obtain as perfect assimilation and excretion as possible is what we are to aim at. Any excess of food beyond this only weakens the powers of digestion and

[1] Traitement de la Phtisie Pulmonarie.
[2] British Medical Journal, February 22, 1902.

assimilation and interferes with normal functional activity by an excess of excretory products.

There is now a large amount of evidence from sanatoria and phthisiotherapeutists regarding the diet and amount of food necessary in feeding consumptives. The consensus of opinion seems to be that from 3000 to 3500 calories per person per day is sufficient for the average consumptive in the proportion of: Proteins, 500 to 700 calories; fats, 1300 to 1500 calories; and carbohydrates, 1200 to 1300 calories. Both the amount and the proportions must be varied, however, according to individual conditions. Most phthisiotherapeutists at the present time do not favor forced feeding or excessive amounts of food, except in rare cases.[1]

A careful painstaking study of the digestion, both gastric and intestinal, should be made in each individual case. If there is any evidence that gastric digestion is at fault, the stomach-contents should be analyzed after a test-meal; also the effect of various articles of food is to be carefully noted. Dyspeptic symptoms are to be studied in relation to the diet, both in respect to its quantity, quality, and variety. A relief for these symptoms is to be sought in a regulation of the diet rather than in drugs. If a sufficient amount of food can be taken and digested it does not matter very much whether there is an appetite for it or not. Chittenden considers the appetite an uncertain guide. Bardswell, Goodbody, and Chapman, before referred to, conclude from their investigations that the diets, as regards amounts and constitution, should be determined in each case after due consideration has been given to the respective conditions with reference, first, to the activity and extent of disease; second, to the amount below weight; third, to the digestive capability; and fourth, to some extent, to the personal dietetic likes and dislikes.

Innumerable special dietaries and innumerable kinds of special foods and methods of feeding as to amounts and frequency have been advocated and have their adherents, but the experience of the wisest and most skilful phthisiotherapeutists is that each tuberculous individual must be a law unto himself in this respect, and the diet adapted to his individual demands and conditions. Furthermore, it has not been found that any great excess of one kind of food to the exclusion of other articles common to a usual dietary is of advantage, or as well, unless in exceptional cases. An exclusive meat-and-egg diet, for example, which is frequently advocated, is not to be commended except in special instances. In general, a mixed diet is the best, with perhaps an excess of fatty material in the form of butter, cream, olive oil, and other vegetable and animal fats. Delicate breakfast bacon and carefully made sausages are some of the useful and acceptable means of providing fat.

Vegetables are insisted upon by Brehemer on account of the help

[1] Bardswell and Chapman, Diets in Tuberculosis, London, 1908; Herbert Maxon King, On the Construction of an Efficient and Economic Diet in Tuberculosis, Transactions of the Fifth Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, 1909, p. 154.

they afford in the deglutition of other articles of food, especially meat, and thus rendering it more palatable.

A variety of well-cooked, appetizing food, consisting of meat, vegetables, bread, butter, fats of all kinds, cheese, fruits, sugar, and an abundance of milk in as large quantities as the patient can assimilate, is the desirable diet for the average afebrile consumptive, and we now turn to the consideration of the times and manner of taking food, which again must depend largely upon the individual.

Walther, of Nordrach, gives but three meals a day—breakfast at 8, dinner at 1, and supper at 7 o'clock—and he has his patients rest an hour before each meal. He insists, however, that his patients should eat everything that is placed before them.

In many of the European sanatoria food is taken at more frequent intervals—about five times a day. On arising in the morning a glass of hot milk; later, from 7.30 to 8.30, breakfast; at 10 o'clock, a lunch, consisting of bread and butter, cold meat, fruits, etc.; at 1 o'clock, dinner; at 4 o'clock, lunch—milk, bread and butter, or one or two eggs; at 7 or 7.30, supper, which is a hearty one; and, finally, at 9 o'clock, a glass of milk with bread and butter if desired.

Cornet considers that the number of meals should be at least five, while Latham follows Walther's system, and believes that at least five hours should intervene between meals.

Milk is a very important article in the dietary, and is to be taken in liberal quantities, either at or between meals. While the patient is striving to increase weight, as much as three pints or even more may be taken daily under these circumstances.

The first requisite, then, in the feeding of the patient is that a sufficient amount should be taken, and that it should consist of proteins, carbohydrates, and fats in proper proportion; that it should be varied, well cooked, and served in a tempting way. The length of the intervals in taking food must depend upon the results. In some cases frequent feeding will enable the patient to ingest a larger quantity in the twenty-four hours and with more ease. In other cases we can maintain the digestive and assimilative powers in better condition by the three daily meals. One will frequently find it advisable to vary from one method to the other.

The meals should be served at exact times, that a habit may be established of desiring food at fixed periods, or at least a mental preparedness for taking it, whether or not appetite exists. The physician cannot be too exact in his rules as to the feeding, the times, quality, quantity, method of cooking and serving, the time spent in eating, etc. All should be carefully arranged and constantly supervised by him and the *menu* written out. To simply tell the patient to eat well, or as much as he can, is a very inadequate conception and fulfilment of the physician's duty in regard to this all-important part of the treatment, and failure is imminent if the question of feeding is thus cursorily dismissed.

Thus far we have been going on the supposition that the patient has a fairly normal digestion and more or less appetite, or, at least, he is able

to take the amount and kind of food considered necessary for his needs. The case is generally, however, not such an easy one as this as regards feeding, for frequently more or less anorexia and dyspeptic symptoms complicate the matter. The patient has, or imagines he has, an antipathy to certain kinds of food—milk perhaps more than any other—and our ingenuity will be taxed to the utmost to obviate these various perturbing conditions, so that we can succeed in producing a satisfactory food intake and an adequate assimilation. Unless this can be accomplished, the case is doomed. "The consumptive who does not eat is a consumptive lost!" says Moeller.

Although, as has been stated above, food can be taken and digested without appetite, yet the appetite is the natural incentive to eating, and without it the patient will not ordinarily eat enough, so that we must have recourse to some artificial means of stimulating the appetite when it fails.

First, every attempt must be made to present the food in an appetizing way and in small amounts at a time. If constipation exists, this must be relieved, and the attempt to do this should be made at first by means of the diet. Stewed prunes, stewed onions, oranges, figs, stewed rhubarb, and other laxative fruits or vegetables, cream, or more fat of other kinds are useful for this purpose. A glass of warm water before meals may avail. If not successful with these means, some of the simpler laxatives may be used, such as cascara sagrada, the aloes, belladonna, and strychnin pill, aloes, senna, some of the effervescing laxative salts, such as citrate of magnesia, Carlsbad salts, or some of the various natural bitter waters, as Apenta, Pluto, Hunyadi János, Friedrichshall, or even a glass or two of pure water taken before meals. The simpler the means the better. Abdominal massage, or the faradic current of modern strength, enemata of warm water and olive oil, or of glycerin or normal salt solution, may be all that is required. When once a laxative is found which is satisfactory, and as nearly as possible imitates nature, a regular use of this is preferable to an alternating constipation and relief from the same by an irregular use of laxative remedies. An occasional use of the following is of service:

℞. Massæ hydrargyri,
Pulveris aloes socotrinæ,
Pulveris ipecacuanhæ.....āā gr. xiij (0.76)
Pulveris capsici.....gr. xij (0.85).—M.
Ft. pil. No. xxvi.
Sig.—One or two at night.

Or small repeated doses of calomel.

The teeth must be kept in order, for "well masticated is half digested." Each time after the taking of food the teeth and mouth should be cleansed, and for cleansing purposes some of the various mild antiseptic solutions, such as those containing eucalyptus, boric acid, thymol, and similar substances, may be used.

The subject of the various digestive disturbances will be considered under the section upon the treatment of special symptoms, but the

matter of anorexia—loss of appetite—a most common, if not a constant, symptom of pulmonary tuberculosis at some stage of its progress must receive some further attention in this connection, for "the patient must eat and eat with appetite." The hope and the expectation are that with the open-air life, rest, and a change of climate the appetite will without further stimulation revive. If by careful investigation the digestive function can be found to be fairly normal and effective, even without a sense of appetite, as has been mentioned above, a fair amount of food can be taken even if under some compulsion, and not infrequently appetite, like rumor, "grows by what it feeds on." Of course, it is obviously far more satisfactory and certain to establish in the patient an appetite and a desire for food. When the other general means mentioned above fail, we must have recourse to more special and specific agents for stimulating the appetite. Hydrotherapeutics in one or another form of application, such as wet-packs or compresses, sponging with cold water, either alone or with alcohol or salt, may produce successful results. Gastric lavage in other cases or electricity may again be of service. Alcohol, in the form of various light wines, such as claret, hock, Rhine wine, Bordeaux, Hungarian, or diluted whisky, or some of the bitter beers, such as ale, stout, or lager beer, taken at meal-time, may not only stimulate the appetite, but also aid digestion.

With regard to the use of alcohol in general in the treatment of tuberculosis opinions differ greatly, and no hard-and-fast rule can be laid down. If used in any form, one should exercise great discretion and carefully watch the effect. As a routine measure it should never be used. Many German phthisiotherapeutists testify to the value of alcohol as an aid to appetite, and in many of their sanatoria it is used to a limited extent in one form or another. Besides the aid it renders to the appetite, it is also considered to increase the fat-forming tendency. In the Nordrach Sanatorium, which has produced such good results, alcohol in all forms is strictly forbidden, and only in very exceptional cases is it prescribed by the physician for very weak persons. On the contrary, Latham says that "experience has shown that alcohol is of the greatest possible service when fever is present. It saves," he says, "the body protein, stimulates the appetite, and in small doses hastens gastric digestion. It favorably affects the night-sweats and the sleeplessness. When solid food cannot be taken, alcohol is our sheet anchor. Nothing but good results from the administration of large quantities when fever is present, so long as the pulse is becoming slower, the appetite better, the skin and tongue moister, and the patient quieter." It must be remembered, however, that this is in England and not America.[1]

Like other drugs, alcohol must be used only on clear indications that it will be of value, either in the general treatment or in the treatment of certain special symptoms, and neither one extreme nor the other is wise.

[1] The Principles of the Dietetic Treatment of Pulmonary Tuberculosis, by Arthur Latham, M. D., The Practitioner, London, Jan., 1905.

The percentage of alcohol in the various wines, beers, and stronger alcoholic beverages is given by various authorities as follows:

	Percentage of alcohol.
Whisky	50 to 58
Brandy	46 to 55
Rum	40 to 45
Sherry	30
Port	15 to 18
Madeira wine	17 to 20
Sauterne	12 to 15
Rhine wine	8 to 15
Bordeaux wine	8 to 14
Claret	8 to 13
Hungarian wine (white)	8 to 10
Hock	9 to 12
Tokay	12
Champagne	8 to 10
Porter, ale, lager beer	3 to 8

The vegetable tonics, such as gentian, cinchona, cardamom, columbo, quassia, are available for the appetite, and they may be exhibited either alone or in combination, changing from one to the other from time to time, and in this way we may obtain better results. Quinin and strychnin are often efficacious as well as nux vomica, which may be used in combination with any of the above tonics.

Flick considers strychnin one of the most useful remedies in the treatment of phthisis and an undoubted stimulant to nutrition. With this opinion many other phthisiotherapeutists are in accord.

One of the mineral acids, such as hydrochloric, nitromuriatic, or phosphoric acid, in combination with pepsin, is again frequently useful. If gastric digestion is sluggish or impaired, Vermouth, preferably the Italian variety, taken just before a meal, is an agreeable and often a valuable appetizer. Some of the table condiments, like "chow-chow" and the various sauces, may prove to be good tonics.

When the ordinary articles of diet are refused, or taken with repugnance and only sparingly, special forms of food may be tried, and here the skill and ingenuity of the physician will often be taxed to the utmost to find some form or preparation of food which can and will be taken, and which will supply the desired kind and quantity of nutriment. Milk naturally holds the first place, and there are many ways of preparing a milk diet by which it can be made more palatable than in its plain, raw form. An alkaline water, such as Apollinaris, Seltzer, or Vichy, may be shaken up with the milk, or a little salt added to it, or a little tea, coffee, or cocoa may favorably modify its taste. A teaspoonful of brandy, a few drops of Jamaica rum, added to the milk, or cream mixed with an equal part of hot water, as Yeo suggests,[1] adding to each teacupful of the mixture a teaspoonful of the aromatic spirits of ammonia, are other expedients for rendering the milk palatable. Cream added to the milk or mixed with toast (milk or cream toast), zwieback, arrowroot, or used with any of the various cereals, or with Mellin's or Horlick's food, is still another form for a milk diet. Modified milk, after the manner of its

[1] Food in Health and Disease.

preparation for infants, with some of the casein extracted, as suggested by Cornet, is again another expedient. Then we have the various forms of peptonized milk, gruels, junkets, whey, etc. A form of almost universal use in the German sanatoria is fermented milk under the name of "kumiss," which can either be prepared at home or obtained at the shops. Again, buttermilk is agreeable to some patients. Milk may also be used in the various forms in combination with eggs.

The times of taking milk and the quantity at a time must be determined by observation and experiment with each patient. With some, small quantities at frequent intervals proves to be the most successful method; with others, a glassful or more is comfortably taken at longer intervals.

Other special articles of diet, which may aid us in keeping up the nutrition with patients who have little or no appetite, are chopped meat browned in the oven, or minced meat slightly cooked, powdered meat, the various meat-extracts, such as Liebig's or Valentine's, carefully seasoned; toast and meat juice, raw meat juice mixed with ordinary beef-tea; eggs beaten up with milk, either with or without wine, and delicately flavored; meat jelly, wine whey, custard, chicken breast, squab, etc. Coleman[1] speaks highly of egg-albumen prepared in the following way: The white of the egg is clipped with scissors to keep it from cohering, and to it is added a little crushed ice, orange-juice, and a pinch of salt.

Dr. Jane H. Walker[2] has found that by giving the bulk of the proteins and carbohydrates separately in certain cases—meat and toast in the middle of the day and vegetables and puddings in the evening—better results are obtained.

There are innumerable prepared and artificial foods, malt, meat, and albumin preparations. The peptones and albumoses are often of temporary value, but are only to be considered as an aid and not the main reliance. If special diets or special food preparations are used for a while, every effort should be made to return to the ordinary mixed diet as soon as possible. One of the most universally applicable forms of light food is Horlick's malted milk, and most patients can take this preparation with ease and for a long period of time when they are unable, or think they are, to take ordinary milk. With some individuals the malted milk appears to produce a soporific effect, and hence a cup of malted milk at night is often of much value in securing a good night's rest.

From time immemorial the fatty preparations have been advocated and used in pulmonary tuberculosis, for almost always the consumptive is below weight, and an evident indication is to increase it, and the natural fats are chosen as the easiest way of accomplishing this. Many fatty preparations are available for this purpose—cream, butter, animal and vegetable fats, and oils. It has been observed, moreover, that consumptives, as a rule, absorb fats well. Butter and cream can be used as

[1] Klebs, Tuberculosis, 1909.
[2] The Modern Nursing of Consumption, London, 1904.

such as well as in the preparation or dressing of many articles of food. A limited amount of fat meat may be taken in the form of bacon, pork, the fat of roast beef or mutton, and that of various fowls. Olive oil on salads is an attractive way of giving fat, and for this purpose cotton-seed oil is equally good. Cod-liver oil has of late fallen into disuse, at least, from the point of view of its medicinal value, but in the writer's opinion it is of value in certain cases as a food where other means of obtaining a sufficient fat intake fail. It is easily assimilated, and in the majority of cases, in the writer's experience, it can be taken in its pure form, although many declare their inability to do so after an insufficient trial. The pure oil is much to be preferred to the best of emulsions. A small dose, generally a teaspoonful, is best in the beginning, taken once a day, preferably one or two hours after a meal, or at night after a light meal just before going to bed, as Hare and Ransome suggest. By degrees the dose can be increased to a tablespoonful or more, and it can be taken from one-half hour to an hour after each meal, It may be floated upon lemon-juice, coffee, syrup of orange-peel, ginger, or placed in whisky, brandy, or milk. Hare suggests also tomato ketchup as an excipient, or some material of decided taste, like strong peppermint, ginger, lemon drops, etc., may be taken immediately before and after the oil. Its most valuable services are rendered in the earlier stages of the disease when there is no fever. If fever or diarrhea is present, or if, after a fair trial, nausea, vomiting, or other digestive disturbances are produced by it, we should abandon its use. When the pure oil is not tolerated, an emulsion may be tried, although any emulsion is far less efficacious than the oil because it contains so much less oil. The pancreatized form of emulsion is considered the most eligible.

The number of emulsions in the market are very large, made in many different ways and containing varying amounts of oil, some with malt extracts and other ingredients supposed to increase their efficacy. It is often the best plan to make the emulsion at home. The following formula is the one used for many years at the Boston dispensary:

℞. Acidi phosphorici diluti.....ʒiiss (10 cc.)
Liquoris calcis,
Mucilaginis acaciæ.....āā ʒv (20 cc.)
Olei morrhuæ.....ʒxiiss (50 cc.)
Olei gaultheriæ.....q. s.—M.
Sig.—Teaspoonful or more at a dose.

The following method may be used for home preparation:

℞. Vitelli ovi.....No. v
Olei amygdalæ amaræ.....♏x (0.6).—M.

Mix thoroughly in a mortar and then add drop by drop at first, constantly stirring,

℞. Olei morrhuæ.....Oj (400 cc.)
Glycerini.....ʒij (60 cc.)
Acidi phosphorici (Squibb's concentrated)...ʒj (16 cc.)
Spiritus frumenti,
Aquæ.....āā Oss (250 cc.).—M.
Sig.—Tablespoonful at a dose.

The variety and quality of the oil are all important. That obtained from the fresh livers of the fish is the best, and, although a light-colored oil is generally on the market, the dark variety is considered more active. The Norwegian oil is a standard brand. The cod-liver oil extracts may be of value from the various salts contained, but they are certainly u eless as fats.

In concluding the consideration of diet it cannot be too strongly impressed upon the practitioner that the nutrition and feeding of the tuberculous patient are of the very highest importance. No perfection of the open-air treatment will avail without good feeding.

"My pharmacy is my kitchen!" is the often-quoted remark of Dettweiler, and, as Walters truly says, "The diet for a consumptive will have to range from the fever diet of a hospital to the elaborate dietary of a high-class hotel."

One must not only in detail direct the diet, but must personally see that his directions are carried out.

Burton-Fanning declares that the important items of a consumptive's food should be ordered in definite amounts and weighed each day, until by practice one has learned to guess at the amounts with sufficient accuracy, not only in the home treatment, but in institutions. Failure has resulted from a neglect of this vital factor of the treatment—*nutrition.*

The writer has always remembered the emphasis with which Walther, of Nordrach, insisted upon his personal supervision of the selection of his food material. A good larder and a good cook are indispensable in the treatment of this disease.

The following is a suggestive and eclectic ménu for one who is in the early stages without fever, and who possesses a fair appetite and digestive ability:

7 A. M.—A cup of hot milk on rising, with a little salt or bicarbonate of soda in it, or flavored with a tablespoonful of strong coffee.

7.30 or 8 A. M.—Breakfast, consisting of fruit, some cereal with cream and sugar; milk with cocoa or weak tea or coffee; a well-cooked roll or toast with butter; a steak, chop, bacon, fish, poultry, or eggs (boiled or poached), and marmalade if desired; milk as ordered.

11 or 11.30 A. M.—A glass of milk with zwieback or a light biscuit, gruel, or malted milk, "kumiss," or an egg-nog. (This lunch, as well as the afternoon one, may be omitted if the patient's weight is normal and his general condition favorable.)

1.30 P. M.—Dinner, consisting of soup, preferably consommé, fish or poultry, rare roast beef or mutton with dish gravy, lamb or fowl; potatoes and one or two other fresh vegetables, according to the season; salad of lettuce, tomatoes, etc., with mayonnaise dressing, bread or toast if desired; a simple pudding, or stewed fruit, prunes, apples, etc., or fresh fruit. According to indications, a small potion of claret and water if ordered, or a glass of beer or ale; cheese; a small cup of coffee. Milk may or may not be taken at this meal.

4 or 4.30 P. M.—Afternoon tea. A cup of beef-tea, broth, a glass of milk with a biscuit, or an egg lemonade.

6.30 or 7 P. M.—Supper. One hot dish, chopped meat on toast, fish, eggs, cold chicken, or meat; bread and butter; tea, milk, or cocoa; boiled rice or some cereal with cream, or cream or milk-toast; baked apples, stewed prunes, etc.

9 or 9.30 P. M.—A glass or more of milk with zwieback, cakes, or bread.

Water as wanted. Easily digested fats, such as cream, bacon, and olive oil, are of especial importance in the comsumptive's dietary.

In many cases only the morning glass of milk and the three meals will be necessary, but when the weight is much under the normal, the intermediary lunches are of value, provided the digestion is not disturbed thereby. The diet, of course, must be largely modified to suit individual needs and conditions, and variety from day to day should be afforded.

Cornet insists upon a quarter of an hour to an hour's rest before and after the noon meal and before the evening meal.

It is not, of course, possible in very many cases to provide elaborate ménus, but in almost every household some one can be found and trained to set before the patient the essentials of a proper consumptive's diet in a tempting form. With the study of a good cook-book, or a treatise on dietetics, or a few lessons in a cooking-school, one can learn to do this. There are also now at hand various diet charts and tables of food values, like those issued by the United States Department of Agriculture, and the admirable chart of Dr. H. D. Arnold, and Koenig's table. By means of these one can determine the relative values of fats, carbohydrates, and proteins, as well as the calorific value of each article of food. A number of illustrative ménus from various very well-known sanatoria and from other sources are herewith appended, for the purpose of more clearly and in more detail indicating the forms of the consumptive's diet.

King, of the Loomis Sanatorium at Liberty, gives the following daily amounts of food from which he obtained the most satisfactory results in quiescent cases:[1]

Soups	5.5 ounces.
Cereals	3.0 "
Meat and eggs	9.0 "
Vegetables	12.0 "
Bread	8.0 "
Butter	1.0 ounce
Milk	62.0 ounces
Cocoa	4.0 "
Sugar	1.5 "
Dessert	2.5 "
Fruit	6.2 "

During the week in which this diet was given in 6 selected cases the average gain per patient was 1.3 pounds. From further investigation and experiment[2] King has found the following standard diet at the annex of the Loomis Sanatorium the most satisfactory:

Protein	130 grams
Total calories	3200

which he considers far preferable to a former one of greater protein and calorific value.

[1] The Sanatorium Treatment of Tuberculosis, The Medical News, July 11, 1903.

[2] An Efficient and Economic Diet in Tuberculosis, Transactions of the Fifth Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, 1909.

SPECIMEN OF THE DIET AT NORDRACH (WALTHER'S SANATORIUM)

Breakfast, 8 A. M.—Coffee, bread and butter, cold meat, such as tongue, ham, sausage, etc., and ½ liter of milk.

Dinner, 1 P. M.—Two hot courses of meat, or fish and meat, about 4 to 6 ounces being served to each patient with plenty of potatoes and green vegetables, and sauces in which butter is the principal ingredient; fruit, ice-cream, farinaceous puddings of various kinds, coffee, and in many cases ½ liter of milk.

Supper, 7 P. M.—One hot-meat course with potatoes, as at dinner, and one cold, as at breakfast; bread and butter, tea, and ½ liter of milk. Occasionally a thick soup, cheese, or pancakes are given instead of one course.

With the exception of breakfast, at which patients are allowed to help themselves, they are helped by the doctor in person, and are expected to eat everything that they are given; and the servants do not remove the plates until everything has been eaten.

SPECIMEN OF THE DIET AT FALKENSTEIN SANATORIUM (DETTWEILER'S)

First Breakfast, 8 A. M.—Coffee or tea with milk; bread with much butter; two glasses of milk.

Second Breakfast, 10 A. M.—*At which the Medical Director is present, as well as all the patients who are able to sit up.* Bread with much butter, fresh eggs, two or more glasses of milk slowly taken.

1 P. M.—*The principal meal of the day.* Soup, fish, meat, poultry, vegetables, salad, dessert, cheese, fruit, red or white wine, coffee.

4 P. M.—One or two glasses of milk, with bread and butter.

Supper, 7 P. M.—Soup, meat, vegetables, salad, preserves, red wine.

9 P. M.—A glass of milk with cognac.

SPECIMEN OF THE DIET AT ROEMPLER'S SANATORIUM (GOERBERSDORF)

Between 7 and 8 A. M.—First breakfast, consisting of bread, rolls or toast, honey, and a liberal amount of butter; ¼ to ½ liter of milk taken in small swallows.

10 A. M.—A glass of milk.

1 P. M.—A good, fat-rich dinner of liberal variety, with 1 or 2 glasses of wine.

4 P. M.—Glass of milk with zwieback or butter biscuit.

7 P. M.—Supper with warm and cold meat, potatoes, rice, salad, preserves, wine.

9 P. M.—Glass of milk with the addition of 1 or 2 teaspoonfuls of cognac.

At the *Sanatorium of Arosa*, in Switzerland, which is frequented by the French, soup is taken before breakfast. There are two breakfasts, a midday meal, afternoon tea, and an early and late supper. About 1 pint to 1½ pints of milk are supplied to each patient.

Fanning,[1] from the conclusions arrived at by Goodbody, Bardswell, and Chapman, considers that the consumptive's dietary should consist of 4¼ oz. of proteins, 5 oz. of fat, and 10½ oz. of carbohydrates, and he constructs a standard daily diet representing these amounts, as follows:

		Approximate Value.	
		Protein.	Fat.
Meat	4 to 5 ounces	1 ounce	½ ounce.
Milk	3 pints	2 ounces	2½ ounces.
1 egg	2 ounces	¼ ounce	⅕ ounce.
Porridge	Plateful	⅓ "	
Bread	8 ounces	1 "	
Butter	2 "	Trace	1½ ounces.
Potatoes, etc.	4 "		
Pudding	Plateful		
Total about		4½ ounces	4½ ounces.

[1] Practitioner, January, 1905.

This is distributed during the day as follows:

Breakfast.—Porridge or bread and milk.
1 egg. Bacon or ham, or fish, etc. ..... 1 ounce.
Bread. Butter ..... ½ "
Tea, coffee, or cocoa. Milk ..... ½ pint.
11 A. M.—Milk ..... ½ pint.
Lunch.—Meat ..... 2 ounces.
Bread, vegetables, puddings. Milk ..... ½ pint.
Dinner.—Meat ..... 1 to 2 ounces.
Bread, vegetables, puddings. Butter ..... ½ ounce.
Milk ..... ½ pint.
Supper.—Tea, coffee, or cocoa. Milk ..... ½ pint.
Bread, biscuits, etc. Butter ..... 1 ounce.
Bedtime, or on waking in the morning. Milk ..... ½ pint.

SPECIMENS OF THE DIETARY OF THE STATE SANATORIUM AT RUTLAND, MASS. (1910)

(Kindness of Dr. Hills, Sup't.)

House Dietary.

BREAKFAST.	DINNER.	SUPPER.
	Friday, April 15.	
Cream of wheat.	Corn soup.	Corn flakes.
Codfish hash.	Boiled salmon.	Baked beans.
Ketchup.	Egg sauce.	Cold meat.
Corn bread.	Roast beef.	Brown bread.
	Mashed potatoes.	
	Canned peas.	
	Pickled beets.	
	Queen pudding.	
	Sunday, April 17.	
Farina.	Consommé with paste.	Cut oatmeal.
Scrambled eggs.	Roast rib of beef.	Cold meat.
Bacon.	Mashed potatoes.	Baked potatoes.
Baked potatoes.	Corn.	
Popovers.	Lemon méringue pie.	
	Tuesday, April 19.	
Cut oatmeal.	Purée of vegetables.	Cream of wheat.
Boiled eggs.	Sirloin steak.	Beef pie, country style.
Baked potatoes.	Baked potatoes.	Stewed prunes.
Plain muffins.	Beets.	
	Fruit jelly.	
	Whipped cream.	
	Wednesday, April 20.	
Rolled oats.	Clear vegetable soup.	Farina.
Fried smelts, tartar sauce.	Roast top of round beef.	Cold tongue.
Sautéd potatoes.	Yorkshire pudding.	Delmonico potatoes.
Corn muffins.	Mashed potatoes.	Stewed apricots.
	Kidney beans.	
	Orange custard.	

Special bread served when ordered. Real and cereal coffee mixed for breakfast daily. Cocoa for supper daily. Bread and butter at each meal. Chops, steak, and eggs served at every meal when ordered by the physician. Lunches of raw eggs and milk served at 10.30 and 3 as ordered. Milk served at breakfast and supper.

Beside the regular house dietary, there is also served a "light and infirmary dietary," similar in composition to that of the house dietary, only somewhat less in amount. Lunches of raw eggs and milk are served in this dietary at 10.30 A. M., 3 P. M., and 8.30 P. M. as ordered.

SPECIMENS OF THE DIETARY OF THE LOOMIS SANATORIUM.

(Kindness of Dr. King, Physician in Charge.)

MAIN SANATORIUM

Cost per person per diem, 72 cents.

Saturday, January 1, 1910.

Breakfast:

Grape-fruit.
Oatmeal. Shredded wheat. Puffed rice.
Scrambled eggs. Boiled eggs.
Ham soufflé.
Baked potato.
Parker House and French rolls. Toast.
Coffee. Tea. Cocoa. Milk.

Dinner:

Lobster cocktail.
Celery. Salted almonds.
Julienne soup.
Roast leg of lamb.
Mint ice.
Chicken pie.
Rice croquettes. Orange sauce.
Cauliflower, cream sauce.
Mashed sweet potato.
Boiled potato.
Lettuce salad.
Peaches Melba. Cheese and crackers.
Coffee. Tea. Cocoa. Milk.

Supper:

Farina mush.
Mixed pickle.
Broiled sirloin steak.
Cold boiled tongue.
French fried potatoes.
Sautéd mushrooms on toast.
Eggs, boiled.
Cereals, force, cornflakes, shredded wheat, etc.
Cottage pudding, lemon sauce .
Toast and rolls.
Coffee. Tea. Cocoa. Milk.

INTERMEDIATE DIVISION

Cost per person per diem, 35 cents.

Monday, January 3, 1910.

Breakfast:

Bananas.
Oatmeal. Shredded wheat.
Cream.
Omelette or boiled eggs.
Rolls. Butter.
Coffee. Cocoa. Milk.

Dinner:

Bouillon.
Roast spare ribs.
Sauerkraut.
Sweet-potato croquettes.
Boiled potatoes.
Plum pudding, brandy sauce.
Bread and butter.
Milk.

Supper:

Roast-beef hash.
Chicken salad.
Lemon jelly. Whipped cream.
Bread and butter.
Tea. Cocoa. Milk.

THE ANNEX

Cost per person per diem, 32 cents.

Wednesday, January 5, 1910.

Breakfast:

Oranges.
Oatmeal. Force.
Boiled eggs. Toast.
Bread and butter.
Coffee. Cocoa. Milk.

Dinner:

Soup.
Roast leg of veal.
Peas.
Mashed potatoes.
Peach ice-cream. Coffee.
Bread and butter.
Milk.

Supper:

Salmon salad.
Potatoes Delmonico.
Apricots. Fruit-cake.
Bread and butter.
Cocoa. Tea. Milk.

REST AND EXERCISE

Dettweiler may be considered an exponent of the open-air rest cure—"Ruhekur"—and to him we owe the establishment of this method, if such it may be called, upon the basis of successful experience.

In the treatment of tuberculosis it is now agreed by every one that very much rest is beneficial, but the majority of physicians do not go to the extreme that Dettweiler insisted upon, which was almost continual rest. It is admitted by all, however, that fever cases must be kept absolutely at rest, and, furthermore, in the afebrile cases much rest also is insisted upon, especially with those of low vitality and with those who have lost much flesh.

Trudeau and others follow the routine of putting all patients at rest for the first few weeks in the beginning of the treatment, and it is a wise plan to pursue. Later in the treatment the state of the patient's general and local condition must determine how much, if any, exercise he may with safety be allowed to take. In general, the safest period for exercise is in the later stage of the treatment—the convalescent period—when the arrest appears to be well advanced. Again, the general statement may be laid down that whatever exercise is taken, at whatever period in the course of the treatment, it should not be violent or excessive, and never to fatigue or overexertion. In the German sanatoria the favorite form of exercise is slow walking on the level, and later up hill, the speed being not over two miles an hour. When exercise or rest is under con-

sideration, the guides should be the pulse and temperature. If, on trial, there is a rise of the latter, and it recurs on a repetition of the exercise, and if the pulse is unduly accelerated, the exercise is doing harm and should be lessened or abandoned. Moreover, whatever exercise is permissible, rest both before and after meals must be the rule.

Phillip[1] establishes this rule of rest "if the temperature oscillate from day to day above 100.5° F. and the pulse-rate be maintained above 90 beats per minute."

If, however, the temperature is normal, and the pulse-rate not above 80, if the general condition is good, and evidence exists that the local condition is progressively improving, and the weight is normal or increasing, exercise may be cautiously tried and the result watched. After the exercise the temperature is to be noted, and if it reaches 100° F. or more and remains so, even for half an hour, and there is evidence of exhaustion or interference with appetite, it is a proof that exercise has been too severe, and the next trial should be less in amount.

It is only by thus carefully watching and experimenting with each individual case that the question of exercise can be satisfactorily and safely determined for that individual. In general, it must be borne in mind that while there is fever or a disposition to fever, a rapid, irritable pulse, bodily weakness, *anemia*, and a very considerable diminution of weight, the open-air *rest* cure is indicated. As soon, however, as the strength and weight have increased and fever remains absent, then suitable exercise in the open air is indicated. It must be clearly borne in mind, however, that the open-air rest cure is only a part of the open-air cure. Exercise—movement in the open air—is also at the proper time an essential part of the treatment, but exercise of such a kind and in such limited quantity as will not jeopardize the progress of the patient toward recovery. The statement which is often made, even in text-books, that the more exercise the patient is able to take in the open air the better, is misleading, not to say dangerous, advice.

As to the kind of exercise, that must again depend to a certain extent upon circumstances. Walking at a slow or moderate gait, at first on the level and later climbing hills of mild elevation, is probably the safest, as it is the most frequently employed, form of exercise. All violent forms of exercise, like tennis, rowing, dancing, bicycling, and perhaps skating and horseback riding (though authorities differ as to these latter two forms), are, in the writer's opinion, too violent to be safe. Gentle free-hand movements or calisthenics, especially arm movements, may be permitted.

As time goes on and the improvement continues, indicating an approaching arrest, greater freedom in the choice and range of exercise may be allowed, but always with full knowledge on the part of the physician as to the character and amount of it.

Latham[2] says that the answers to this question (exercise), given him

[1] Transactions of the British Congress on Tuberculosis, 1901, vol. iii, p. 191.

[2] The Prize Essay on the Erection of the King's Sanatorium for Consumption, 1903, p. 45.

by some fifty medical men in charge of sanatoria, show that no absolute rules can be given, but that each individual case must be considered by itself.

No general rule can, indeed, be laid down. In general, exercise is good when it does not have a tendency to increase the disease or interfere with its favorable progress toward recovery. Billiards and golf are put on the list of prohibitive exercises by some and permitted by others. English authorities permit golf in convalescent cases.

With the working classes the exercise may be in the form of some useful work, as is practised in the Folk Sanatorium in Germany. Gardening, light farm work, etc., for the men, and a limited amount of housework or light outdoor work, like picking berries, etc., for the women.

Dr. Paterson, of the Brompton Hospital Sanatorium, England, has devised a method of graduated labor for patients while undergoing treatment in the sanatorium, who are without fever and whose general condition and appetite are good and who appear to have established a good degree of resistance. This method of labor he arranges in a series of graded exercises as follows: (1) Walking for half a mile at first and slowly increasing the distance up to six and ten miles a day. (2) Carrying baskets of mold or other material a certain fixed distance, the weight being gradually increased from twelve to twenty-four pounds. (3) Digging with a small shovel with a long handle, and raising the shovelful seven feet into a cart. (4) Digging with a large shovel as before. (5) Using a pickax four hours a day. (6) Using a pickax six hours a day.

Patients in 2, 3, and 4 grades work for four hours a day. Dr. Paterson considers the basket grade the most important of all, and he regards it as the connecting link between walking and working. The grades of exercise and work for women are similar to those of the men, but the various implements, such as baskets, shovels, etc., are smaller in size and the women are not allowed to work as hard as the men. The indications that the patient is taking too much exercise are a loss of appetite, slight headache, and a temperature of 99° F. When this occurs, the patient is immediately ordered to bed. From his experience, Dr. Paterson concludes that graduated labor is a definite medical treatment for cases of pulmonary tuberculosis, and raises the general health and resisting power of the patients.

Dr. Inman, of the Brompton Hospital laboratories, examined the blood of some of Dr. Paterson's patients who were taking the graded exercises and found, by means of the opsonic index, that the exercises induced artificial autoinoculation. In other words, the patient was inoculated by his own tuberculin, as it were, developed by means of his labor. Thus was accomplished the same result, and perhaps more safely, which the injection of tuberculin is supposed to accomplish.

Other kinds of work can obviously be similarly graded, such as gardening, chopping, sawing, carpentering, etc.

As to the value or harmfulness of pulmonary gymnastics there is a difference of opinion. Many good authorities, as Brehmer, Liebmeister,

Volland, Meissen, and Cornet, oppose it, and believe that harm may result therefrom, and in this opinion the writer is inclined to coincide.

Bridge[1] declares that there is no proof that the lung is an exception to the rule that the tuberculous organs do best when perfectly quiescent, and there is much evidence to the contrary, he says. A diseased lung needs to be put to rest so far as it can be. Other authorities consider pulmonary gymnastics as a valuable aid in increasing the thoracic perimeter and vital capacity and in combating the peripheral atelectasis.

As Latham[2] has pointed out, whenever one of the lungs is affected with tuberculosis, even if the disease is limited to the apex, the movement of the diaphragm is sensibly diminished on the affected side, and again, when the lungs become tuberculous, adhesions are formed in the majority of cases between the lungs and the pleura. "By these means," he says, "and by diminishing the movement of the various muscles of respiration on the affected side, nature makes every endeavor to keep the diseased part at rest," and it would appear to be a reasonable deduction that all attempts at respiratory gymnastics, unless the disease is well on toward arrest, are contrary to nature, and might be prejudicial to the favorable progress of the case.

In a series of experiments carried on at the Massachusetts State Sanatorium by the writer and his resident physician,[3] the conclusion was reached that with carefully selected cases in which there were no acute symptoms and with cases well on the road to arrest, pulmonary gymnastics (deep breathing), carefully applied and supervised, appeared to be of some value in hastening the arrest, and the patients expressed themselves as feeling better from their use. The fact seems also to be established that breathing exercises under the above conditions can be indulged in without injury. If employed, however, great care must be taken in the selection of the cases and supervision of the exercises.

The most appropriate time for exercise is in the forenoon, but it must be remembered that one must rest a half-hour or an hour after the exercise and before the mid-day meal, and at the terminus of the walk or climb one must rest before returning.

As time goes on and the patient steadily improves, exercise can be increased, and also taken in the afternoon, so that, finally, even a walk of ten miles or more may be indulged in without harm.

It cannot be impressed upon the practitioner too strongly that probably, as Walther says, more consumptives kill themselves by doing too much than in any other way.

The writer recalls the case of a young man, at Aiken, playing tennis with a fever temperature, and thus unwittingly inviting the fatal termination which occurred some weeks later.

[1] Tuberculosis, W. B. Saunders Co., 1903, p. 214.

[2] The Prize Essay on the Erection of King Edward VII. Sanatorium for Consumption, London, 1903, p. 38.

[3] Edward O. Otis, Use and Abuse of Pulmonary Gymnastics; Henry B. Dunham, Pulmonary Gymnastics in Tuberculosis, Boston Medical and Surgical Journal, July 19, 1906.

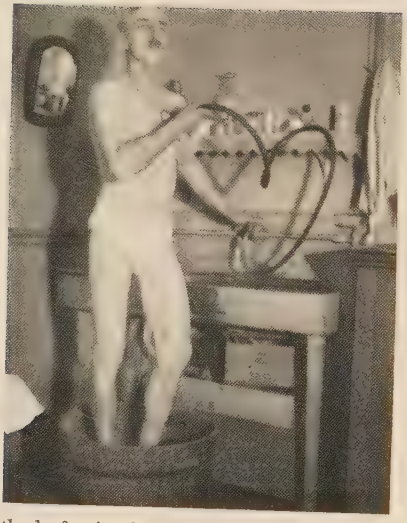

Fig. 76.—Method of using hose douche attached to a common faucet.

THE USE OF WATER: HYDROTHERAPEUTICS

The hygienic-dietetic cure, and all it involves, is sometimes also called the "hardening process," or, better, hardening may be considered as part of the general scheme for increasing the body resistance. The outdoor life in itself, in all kinds of weather and in varying temperatures, is a hardening process of the first importance, as any consumptive can testify who has begun it in northern latitudes in the colder months of the year. The use of cold water in varying forms is another and a very important method of hardening in this process, and added good results follow from its use. The action of the skin is improved and the susceptibility to temperature and climatic changes lessened; the appetite is increased and the whole system stimulated.

With a delicate patient one may, as a preliminary process, begin with dry rubbing, as recommended by Dettweiler, morning and night—either simply with a coarse towel or a rough hand-glove, or by placing the patient in a coarse sheet and then rubbing him over the sheet. Later, moist rubbings can be substituted by means of a wet, coarse cloth, or by enveloping the patient in a wet sheet, beginning with a temperature of 90° F., and gradually reducing it to 70° or 60° F. With many patients of fair vitality a cool or cold sponge-bath can be taken from the beginning, either over the whole body or to the waist. The only counterindication is a lack of reaction, as shown by blueness, goose-flesh, and chilliness. In such cases the cool sponging should be taken in bed. Salt, alcohol, or brandy may be used in the water.

As Minor[1] has pointed out, "Excellent results can be obtained with no more complicated apparatus than a tin tub, a bath thermometer, a big sponge, salt, and a rough Turkish towel." Minor's method of giving a bath is as follows: One or two buckets of water and a handful of sea-salt are placed in the tub, the water at the commencement of taking a bath being at a temperature of 100° F., which is reduced a degree every day until 70° to 55° F. is reached. The patient saturates a large sponge with water, stands erect, holds it over his shoulders and neck, and squeezes out the whole volume at once in a shower down his back and neck, thus producing a douche. This is repeated rapidly over all parts of the body for about half a minute, when the patient jumps out, rubs off briskly and rapidly with a rough Turkish towel, and then at once dresses. If the strength of the patient is not great, a nurse or attendant can squeeze the sponge and rub. Instead of the sponge a pitcher of water can be held over the shoulders and neck, and thence poured over the body, or a hose with a spray attachment may be connected with any convenient faucet in the house (Fig. 76). If the patient is weak, the rubbings, either moist or dry, should be done by a nurse or one trained for it, and ought not to last more than a few minutes. The patient, if not strong, remains in bed for ten or twenty minutes, or if vigorous, immediately dresses, takes a little fresh air by means of a walk, and then has his breakfast. The

[1] New York Medical Journal, January 14 and 21, 1899.

morning, before dressing, is the most suitable time for such rubbings, or they may be taken immediately after breakfast.

For cold friction the patient stands near the bed and is wrapped in a sheet wrung out in cold water. The whole body is then rubbed firmly and rapidly; the wet sheet is then removed, and a dry one applied, and the patient is rubbed again, and then quickly dresses or rests a short time in bed. A wet-pack can be used, but in the writer's opinion its value for consumptives is limited. Wet compresses to the chest, consisting of napkins or towels wrung out in cold water and covered by a flannel, and the Winternitz cross band, consisting of a strip of linen or sheet wrung out in cold water, and wound about the chest from one axilla to the opposite shoulder, and the reverse, until the whole chest is covered front and back, and this covered with dry flannel applied in like manner, are other hydrotherapeutic expedients.

At the Nordrach Sanatorium arrangements for a simple douche or a shower-bath are placed in the corner of each patient's room, and they are allowed to take douches of any temperature which they find comfortable.

In addition, we have a variety of shower-, douche-, rain-, and needle-baths, but such an extensive hydrotherapeutic equipment would only be found in a sanatorium, and is not really essential.

All the more violent uses of water, such as the douche introduced by Brehmer, are generally applicable only to the stronger convalescent patients, and can be safely given only under the immediate supervision of the physician or a skilled attendant.

The test of the value of any hydrotherapeutic measure of whatever kind is a quick reaction and feeling of warmth and well-being—an improvement of appetite, nutrition, and mental condition.

THE PSYCHOLOGIC TREATMENT

The **care of the patient's mental condition** is an important matter for consideration, and herein the personality of the physician plays a conspicuous part. He must be able to inspire his patient with hope and instil in him a desire and determination to get well. As some one has well said, "the physician must be a schoolmaster and inspirer as well as clinician." The will power and faith of the physician must be infused into the patient, and the physician and patient must be in sympathy. The patient must be put into a restful mental condition, and everything which has a tendency to produce nervous and mental excitement is to be sedulously excluded, such as exciting literature, either in the form of stories or newspaper details of harrowing incidents. Prosy narratives, like Miss Austin's novels, for example, travels, history, humorous narrations, like "David Harum," "The Real Diary of a Real Boy," etc., are rather to be recommended. Exciting games of cards, chess, etc., are contraindicated. Simple games, like the many forms of solitaire, are permissible; botany, photography, basket-making, wood-carving, knitting, paper-cutting, and other similar light occupations are suitable.

If the patient is fortunate enough to have a hobby of any kind, advantage may be taken of this if it does not involve too much activity of mind or body. After all, the patient will learn to remain quietly for many hours in his reclining chair, looking out on the landscape and sky, as the passenger on the ocean steamer spends hours and days simply watching the ever-changing scenery of sky and ocean.

If the patient is depressed and melancholy, a simple occupation may distract his thoughts from himself and his condition. If excitable, he may be soothed by a monotonous drowsy story or game. As recovery progresses greater mental and physical effort may be allowed in the form of some occupation; for it must be borne in mind that the habits of confirmed invalidism, so fatal to future usefulness and activity, may be formed while the "cure" is taking place.

Various trades, such as book-binding, as practised at the Adirondack Cottage Sanatorium, wood work of various kinds, basket-making, etc., may, under proper precautions, be taught, and thus the patient, while he is making the "cure," may acquire a useful trade which will enable him to gain his livelihood after his recovery.

Tranquillity of mind is quite as essential as rest of body, and the physician must strive by every means to establish this desirable mental condition.

As Dettweiler wisely says, "The consumptive must be treated *in toto*, and his moral and mental education is quite as important as his bodily treatment."

A firm religious faith is often a precious asset of the patient, yielding him that peace of mind and restfulness of spirit "which passeth understanding."

CLOTHING

There is no special kind or manner of clothing for the consumptive different from that worn by any well person. Clothing thick enough to keep him warm should be worn and no more. Unduly heavy clothing has a tendency to relax the skin and produce profuse perspiration, which renders the body more sensitive to changes of temperature and conduces to catching cold. Woolen in the cooler latitudes, or merino, which contains a certain proportion of cotton, is probably the best material to be worn next the skin, but it should be only of such weight and thickness as will keep the patient comfortable. If one, however, is accustomed to wearing silk, linen mesh, or even cotton underclothing, their use may be continued.

The clothing should be evenly distributed over the body, and no greater thickness, such as chest protectors, extra vests or jackets, should be worn over the chest than elsewhere.

The undergarments should be loose enough to permit a circulation of air beneath them. "Inside our dress," says Pettenkoffer, "we should carry the air of the south wherever we may be. We live in our dress like an unclothed tribe in a Paradisian country, where the air is constantly calm and the temperature from 75° to 94° F."

The underclothing worn during the day should be removed at night and thoroughly aired.

Women should wear short skirts. Trailing skirts are a menace, both to themselves and others, from the dirt and filth they collect and disseminate.

PERSONAL HYGIENE

Besides the daily cold bath for hardening purposes, a hot bath with soap should be taken several times a week, and this followed by a momentary cold sponge and brisk rubbing.

The teeth should be kept in a good masticating condition, and cleansed both before and after meals with a good antiseptic powder or paste.

The hands and face should be washed before each meal, and the nails always kept well manicured; the hair thoroughly brushed with a stiff brush each morning, and frequently shampooed, care being taken that it is well dried thereafter. If a mustache or beard is worn (although this is not advised), these should be washed several times daily.

Under no circumstances is the sputum to be swallowed, and, as has been before mentioned, the mouth must be frequently washed out.

SLEEP

The patient should be in his bed at the latest by 10 o'clock, in many cases by 9, and accustom himself to sleep from nine to ten hours. Indeed, life in the open air, as every one has experienced, conduces to sound sleep.

As a further preparation for sleep, the evening hours are to be spent in a quiet, restful way. One must cultivate tranquillity of mind, so that "the cares that infest the day, shall fold their tents like the Arabs, and as quietly steal away" in the evening hour when "the timely dew of sleep falls."

PATIENT'S ROOM

If possible, the patient's room should have a southern, southwestern, or southeastern exposure, not only on account of the sunshine, but because it will be cooler in the summer and warmer in winter. It should be of ample size, with abundant window space, and if possible have an open fireplace. The furnishings should be simple and plain, and anything which will collect and hold dust, like upholstered furniture and hangings, is to be avoided. The floor should be a hard-wood one, or covered with some material like linoleum, so that it can be easily washed. Everything about the room should be of such form and character as permits of thorough and ready cleansing. Bedclothes should consist of woolen blankets or eiderdown puffs, the latter having the advantage of warmth and lightness. For several hours every morning the bedclothes and mattress should be placed in the sunlight and well aired. A rug or two may be allowed on the floor. Once a week, at least, the

floors, walls, and furniture should be cleansed with soap and water, or wiped with cloths wet in a solution of 1 or 2 per cent. of chlorinated lime or a corrosive sublimate solution, and, if it can be readily accomplished, once a month a regular disinfection of the room with formaldehyd gas may be done, care being taken in this disinfection that all small articles used by the patient, such as books, cards, boxes, baskets, etc., should receive a thorough fumigation.

The best artificial light is electricity, but as the patient is only in his bedroom to sleep, and perhaps not at this time, the matter of lighting is of small consequence.

The windows, of course, are to be constantly kept open, and if the bed is in the line of a direct draft, it can be shielded by a screen.

A balcony connected with the bed-room, so that the bed can be rolled out upon it through a low window, is a very desirable addition, as has been referred to before.

PRECAUTIONS AND MODE OF LIFE AFTER RECOVERY

As pulmonary tuberculosis is essentially a disease of indoor life, the outdoor life is one of the principal factors, as we have just seen, in the accomplishment of the "cure." The life, therefore, after recovery should be spent, if possible, largely out-of-doors. In brief, very much the same plan of life pursued during the "cure" is to be the model of one's life afterward. A clerk, factory operative, artisan, or one who has pursued any purely indoor occupation must, as a rule, abandon his trade for an outdoor occupation. For example, that of a farmer, milkman, gardener, expressman, etc.

If an indoor life, from necessity, must be resumed, one can live in a healthy suburb and seize every opportunity, by making short hours, to obtain a daily portion of outdoor life, by walking to one's place of business, by an evening walk, by sleeping in a window tent or in the open air, especially in the warmer months of the year.

In some instances, at least, a so-called indoor occupation can be, to a certain extent, converted into an outdoor one by having open windows, or even the whole side of the shop where one works may be removed.

Especial precautions for from two to five years after the "cure" is accomplished are required, for the experience is a common one of a relapse within this period on a return to the former environment and plan of life. Indeed, the "cure" may not be considered as absolutely accomplished until the arrested disease remains so for this length of time.

Excessive physical and mental exercise is to be avoided, as well as all excesses of every kind. The weight is to be watched, and if there are any indications of retrogression from the normal standard of health, such as loss of weight, strength, appetite, etc., the temperature must be taken for several days, to see if the disease has become active again. A bronchitis, "grip," or any respiratory disease must receive immediate and careful attention.

Rest, nourishment, pure air, the avoidance of overexertion, and the general conservation of energy are cardinal principles of living ever to be borne in mind by the cured consumptive.

The objection may naturally be urged that to treat a case with all attention, detail, and a consequent cost, as outlined above, would require a command of considerable pecuniary means, as well as one's entire time for a more or less extended period, and, therefore, would not be within the reach of many patients.

True, the ideal treatment would require much outlay of money and time, but from this plan modifications can be made according to the exigencies of the case, and it is better to have before one an ideal plan of treatment and to come as near to it as we can. Not this or that detail suggested can perhaps always be carried out, but the general principles of the hygienic-dietetic treatment must always be clearly borne in mind.

After the above somewhat detailed discussion of the general management of a case of pulmonary tuberculosis, it may be helpful to give a brief résumé of the essential points which have been previously considered with a typical day's routine or "jour medicale," it being understood that the hypothetic case is in the curable stage:

First: A painstaking examination of the patient is to be made, and an inventory taken of his general and local condition, including the history of the case.

Second: The social and pecuniary condition of the patient is to be determined, including everything concerning his mode of life in the past and his present domestic ties, business conditions, etc.

Third: The plan of treatment is to be laid down according to the general principles of the hygienic-dietetic system, applied and modified according to the patient's individual condition, and in arranging the plan of treatment we must consider:

(1) The place where the open-air treatment is to be applied—at home, in a sanatorium, or in a new climate.

(2) If at home or in a health resort, a systematic exact rule of life must be prepared for the patient's guidance, according to the principles which have just been enunciated.

(3) Every perturbing influence in the environment—disordered functions of body, vicious habits of mind or body—are to be eliminated and corrected so far as possible.

Fourth: From the commencement of the treatment thenceforthward a close supervision by the physician is to be maintained:

(1) As to food and drink.
(2) As to the number of hours spent in the open air.
(3) Conditions of the various bodily functions.
(4) The temperature.
(5) The weight.
(6) Rest and exercise.
(7) Mental condition.
(8) Hydrotherapeutic applications.
(9) Sleep.
(10) Various symptoms that may arise incident to the disease.
(11) Medicinal treatment.
(12) Care of the sputum; cleanliness of the patient and his room.

The patient's daily routine or "jour medicale" may be outlined as follows, and this is supposed to be for a patient in the first or early stage of the disease, who is in the process of arrest, and is able to be about, and who is afebrile:

7 or 7.30 A. M.—Arise, and take a cool or cold sponge or shower-bath and then dress in a warm room. While dressing he may or may not take a glass of hot milk, according to his individual condition. His temperature and pulse are also taken at this time.

7.30 or 8 A. M.—Breakfast, and then rest in the reclining chair, and the prescribed period of rest should be passed without moving from the chair.

9 A. M. or Later.—A walk of a prescribed limit, resting at the end of it in the fresh air before returning (Fig. 78) or other form of exercise.

About 11 A. M.—A glass of milk, or light lunch if ordered.

11.45 or 12 A. M.—In his own room, or on the veranda resting, as before. At this time the temperature may be taken again.

From 12 to 1 P. M. or Later.—Dinner in the dining-room if in a sanatorium, or served to the patient in the reclining chair if for any reason this is considered preferable.

2.30 or 2.45 P. M.—A slow walk, shorter than in the forenoon, or other form of exercise, may be taken if prescribed, again resting as before at the destination, and reaching home about 4 or 5 P. M.

4 or 5 P. M.—The temperature is again taken.

4.30 P. M.—Milk or a light lunch.

5 P. M.—Rest as before dinner, and in the same way in one's room, with the windows open, or on the veranda in a reclining chair.

6.30 or 7 P. M.—Evening meal.

8 P. M.—A half hour or an hour can be spent in a recreation-room with open-air conditions or on the veranda.

9 to 10 P. M.—Take temperature, and a glass of milk if ordered, and retire.

A visit should be made to the patient the last thing at night if in a sanatorium to see that all is properly arranged as to open windows, etc.

At the head of the bed should be a call-bell, so that the nurse or attendant can be summoned in case of sudden illness or other necessity.

Milk or lunches may be taken between meals, according to indications. The weight should be taken each week; a physical examination made every two weeks, and the sputum examined once a month.

The temperature is to be taken in the rectum, if practicable, as giving the most reliable test. If the patient has been afebrile for a considerable time, this daily taking of the temperature may be omitted.

Daily Routine of an Average Patient at Turban's Sanatorium, Davos, Switzerland:[1]

7 to 7.30 A. M.—Get up.

7.30 to 8.30 A. M.—First breakfast: coffee, bread, butter, etc., ½ liter milk.

8 A. M.—Douche if ordered.

8.15 to 9.45 A. M.—Walk on gradient.

9.45 to 10.30 A. M.—Rest in liege hallen.

10.30 to 11 A. M.—Second breakfast: milk (½ liter), bread, butter, etc.

11 to 12 A. M.—Walk on the level as prescribed; rest in liege hallen the remainder of the time.

12 to 1 P. M.—Rest in liege hallen.

1 to 2 P. M.—Dinner, five courses: ¼ to ½ bottle of wine allowed.

2 to 2.30 P. M.—Sit or stand in the garden, cigar allowed if no contraindication.

2.30 to 4 P. M.—Absolute rest in liege hallen; conversation forbidden.

4.30 P. M.—Afternoon tea: ¼ liter milk.

4.30 to 6 P. M.—Walk on level or gradient, with rests as prescribed.

6 to 7 P. M.—Rest in liege hallen.

7 to 7.45 P. M.—Supper, three courses: ½ bottle of beer allowed.

8 to 9.30 P. M.—Rest in liege hallen.

10 P. M.—Bed.

SANATORIUM OR CLOSED TREATMENT

Under whatever conditions or in whatever climate the treatment of pulmonary tuberculosis is carried out, the essential principles of it are the same and may again be repeated:

[1] Schrubsall, Tuberculosis, London, vol. iii, No. 5, p. 223, 1905.

(1) Continuous open-air life in pure air.

(2) Maximum nutrition by means of an abundant dietary.

(3) Rest and, later, limited exercise according to individual conditions.

(4) An environment which shall afford freedom from debilitating influences.

(5) Constant medical supervision.

(6) Hydrotherapeutics and any means calculated to harden the patient and increase his resisting power.

This treatment can be carried out with more or less completeness either at home, as will be later considered, or in a sanatorium. Both methods have their advantages and disadvantages. Neither one nor the other is suited to all patients; both methods will fail unless they are capable of fulfilling the above conditions. In both the treatment must be methodic, exact, and individual. In both the physician in charge must thoroughly comprehend his task and must exercise supreme control and constant supervision. In both forms the necessary means and equipment must exist for carrying out the treatment. Of the two, the sanatorium is the most likely to satisfy the greater number of these conditions. It is built and equipped for the express purpose to which it is devoted, and its supervising physician is selected, or ought to be, for his experience, skill, and personal fitness for this especial work. The results have abundantly testified to the advantages of the sanatorium. So fully has it justified its existence that almost every civilized country has one or many such institutions, and their number is rapidly and constantly being augmented. Furthermore, the sanatorium is the best way whereby the poor person suffering from the disease can, as a rule, be properly treated, and the so-called "paying sanatorium" offers to the well-to-do advantages which only with difficulty and greater expense can be obtained at their own homes.

Another advantage of the sanatorium is the constant presence upon the ground of the physician-in-chief and his assistant physicians. In the majority of the sanatoria, the physician sees his patients several times a day, and eats one or more meals with them in the general dining-room, so that they are kept constantly under skilled observation.

Such is the perfection of the treatment now arrived at in the best and most skilfully conducted sanatoria that it seems to be almost independent of climate.

"I can cure tuberculosis in any climate," was the confident remark of Dettweiler, once made to the writer.

Another advantage of the sanatorium is the isolation and the training of the patient. Even with the best intentions and the exercise of great precaution, there is always present the possible danger of infecting other members of the family in the home treatment, particularly those in constant attendance upon the patient. This danger is obviated on removal to a sanatorium.

It is only after a long and repeated effort that the physician can train the average consumptive patient in the ways of the open-air treatment,

and he may never perfectly succeed. The sanatorium, by precept and example, more readily and perfectly teaches this all-important lesson. Even if the patient is to be treated at home, the writer has found that a few weeks spent at a sanatorium is the quickest way in many cases to learn the open-air treatment. The patient sees day after day how it is accomplished, and thus by observation quickly learns the method.

There are certain *alleged disadvantages* of a sanatorium which deserve attention for a moment:

First, a frequent objection is the supposed depressing influence from the aggregation of so many consumptives in various stages of the disease. The fact is, however, as attested uniformly by sanatoria directors, and from the observation of the writer in visiting a considerable number of sanatoria, and as visiting physician to a large state one, quite the reverse. The patients encourage one another; improvement observed in one patient inspires another. The physician-in-chief, if he possesses the requisite qualifications, encourages and inspires all. Furthermore, the time of the patient is so fully occupied with the "cure" that he has no opportunity for depressing introspection.

In a private letter to Dr. Trudeau from one who had spent some days in a sanatorium, the writer says, "A happier set of invalids I never saw. At my table none looked ill, and were as intelligent, refined, and jolly a crowd as I have seen all summer. I have visited in my time many hospitals, asylums, and homes, but none like this."

In a sanatorium the patient is made to feel that he is wasting no opportunity. He is encouraged to give himself up unreservedly to the guidance of the physician, and his only care is to follow out from day to day the routine of life arranged for him. He divests himself of all responsibility, which is one of the most favorable attitudes of mind for improvement and recovery.

A second objection is the danger of a reinfection of the inmates from one another. Abundant proof is at hand to dispel this apprehension. Nowhere else is such scrupulous care taken to destroy the sputum and guard the patients from all risks in this respect as in a sanatorium. Examination of the dust in various sanatoria and consumptive hospitals has shown that it does not contain tubercle bacilli.

Another objection urged is that the sanatorium is a menace to the neighborhood in which it is situated. It has been shown, on the contrary, that in communities where sanatoria exist the sanitary conditions have improved, the death-rate has fallen, and the cases of tuberculosis have diminished. This has been notably marked in Falkenstein and Goerbersdorf.

A very valuable incidental influence of a sanatorium is the dissemination of the knowledge of the proper hygienic and dietetic principles by its graduates, who, as they go forth, become enthusiastic apostles and teachers of fresh air, proper nutrition, and personal and domiciliary hygiene. This influence has been strikingly illustrated in the case of the Massachusetts State Sanatorium at Rutland.

The *principles* of *sanatorium treatment* are the same as the principles of treatment in general, and have already been discussed above in detail.

The situation, construction, and management of a sanatorium are determined with one end in view, namely, to furnish with efficiency, comfort, and economy the most perfect conditions for the hygienic-dietetic or open-air treatment, and in the establishment of such an institution we have to consider the climate, location, building, and general management.

As to climate, the ideal situation for a sanatorium is in the climate most beneficial for the treatment of tuberculosis, and in the establishment of many sanatoria this matter of climate has been given the first consideration, as, for example, at Davos, Colorado, New Mexico, southern California, and many other places. Generally, however, the situation is determined, in part at least, by nearness to those to be served, by their pecuniary condition, and by the limitations of the country or state whose citizens the sanatorium is to serve. Norway or England, for example, can only select the most eligible locations within their boundaries; so with the State sanatoria in our own country, each State must be content with the best location within its borders. There is much in favor of a site not far away from the home of patients.

With private sanatoria a greater freedom of choice is possible, as in the Adirondacks, the dry pine belt of the south, the high altitudes in Colorado, southern California, or the arid plains of the southwest.

The situation of the sanatorium as regards drainage, water-supply, shelter from prevailing winds, freedom from dust or impure air, is, of course, of the first importance. The grounds should be extensive, from fifty to one hundred acres or more if possible, in order that abundant opportunities for walking and exercise may be afforded, as well as other occupations, such as gardening, farming, etc. More or less elevation is desirable, and shelter from the north wind should be afforded, either by erecting the sanatorium on the southern slope of a hill or by forests of fir, pine, or other trees to the north. The soil and subsoil should by dry and porous, or sandy and well drained. Convenience of access is an important consideration, and consequently the sanatorium should not be too distant from a railway station, with a good road leading to it. The beauty and extent of the view are also an important consideration, for the patient's life will be a confined one, and he needs the inspiring influence which a broad, far-reaching view of varying scenery affords him; such, for example, as one has at Falkenstein, Liberty, Davos, and at many of the other medium and high altitude resorts.

As to the construction and plan of the buildings, much will depend upon the site, the number and character of the patients to be accommodated, and the amount of money available, and the latitude and climatic conditions of the location.

The main object in sanatorium construction is to afford patients continuous open-air conditions of living, whatever the type of building adopted. In public sanatoria this must be accomplished at as small an expense as possible. Any plan which will accomplish this purpose

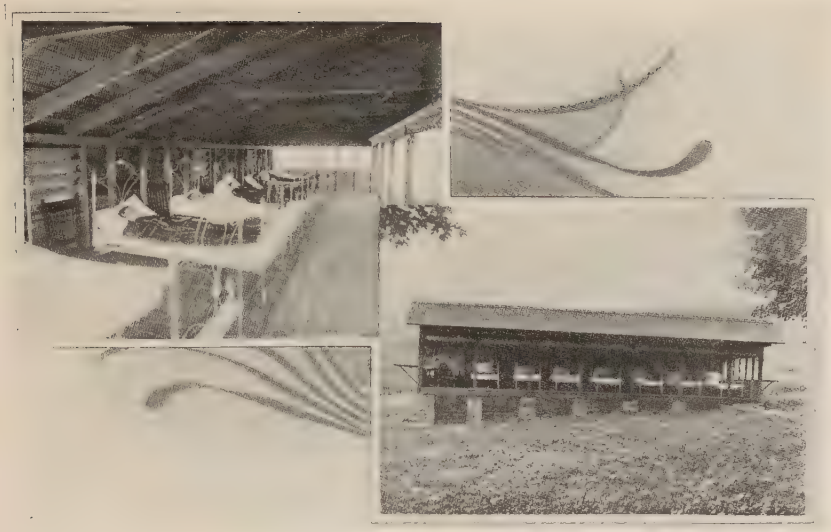

Fig. 77.—Interior and exterior of "Lean-to," in connection with Annex of Loomis Sanatorium.

Fig. 78.—Loomis Sanatorium Annex—Anna Loomis Memorial "Lean-to."

Fig. 79.—A lean-to or "shack" of one of the Massachusetts State Consumptive Hospitals (at Westfield).

Fig. 80.—Massachusetts State Consumptive Hospital (Reading).

Fig. 81.—Massachusetts State Consumptive Hospital (Westfield).

fulfils the conditions of a successful sanatorium, so far as the fresh-air side of the treatment is concerned. There must, of course, in addition, be good administration, expert medical supervision, and adequate facilities for supplying and properly preparing food. It is not by any means that elaborate and costly buildings and equipment necessarily produce the best results. It depends rather upon the most perfect utilization and adaptation of such conditions as exist by a skilled and resourceful physician. Not infrequently structures already existing, like a farmhouse or even a barn, may be so transformed as to be serviceable for sanatorium or administrative purposes.

In general, the guiding principle to-day in sanatorium construction in this country is extreme simplicity and inexpensiveness, a striking contrast to the huge and stately structures characterizing so many of the German sanatoria. The Millet shack, with its development into the King "lean-to" (Fig. 77), a union of several shacks under one roof, so to speak, seems to be the most popular form for sleeping quarters now adopted in this country, and while adhering to this general plan, many modifications can be made according to circumstances. The Millet shack (Figs. 33 and 34) is simplicity itself, and consists merely of an open-air portion for sleeping by night and resting by day, and a small room that can be heated for dressing, bathing, and toilet purposes. The sleeping and day room is open in front, looking toward the south, and also in the rear, although provision is made for closing the back wall when necessary from inclement weather or other reasons. In the modified King's "lean-to" (Figs. 78 to 80) there is a sleeping gallery entirely open in front, with sufficient space in front of the bed for sitting or reclining by day. There are also locker and toilet rooms, and in the central part of the structure a sitting room.

With a series of these "lean-tos" placed fairly near one another and as near as possible to the central or administration building, with an infirmary, which the writer believes is an essential part of every large sanatorium, together with the administration building, we have the sanatorium complete, and such an establishment can be erected at a very moderate expense. Heron thinks that a well-equipped sanatorium for the poor should not cost more than $400 per bed. In the State of Massachusetts three consumptive hospitals built on the sanatorium type, and accommodating 150 patients each, have been constructed and equipped for $100,000 each, including the land, which is about $700 per bed (Figs. 81 and 82). In the New York city sanatorium at Otisville, the cost per bed was as low as $250, but the shacks and "lean-tos" were extremely simple and plain. The cost of the improved "lean-tos" devised and erected by Dr. King, of the Loomis Sanatorium, providing accommodations for 16 patients, was $1830. Dr. King thinks that buildings of this character could be erected for $100 per bed or less, and the entire sanatorium, with a central administration building and all its accommodations, the various necessary outbuildings, infirmary, and "lean-tos" for the accommodation of 100 patients, has been estimated by Dr. King as costing approximately $80,000, or about $533 per bed,

and for the accommodation of 50 patients, $38,000 or $760 per bed. The cost of the Millet shack or cottage is about $200.

The cottage type of building, such as exists at the Adirondack Cottage Sanatorium (Fig. 84), the Loomis Sanatorium at Liberty (Fig. 85), and others, is perhaps the most satisfactory plan for private sanatoria, where persons from good homes, and with whom expense is not a consideration, can obtain the privacy and special nursing and attendance not afforded in the "lean-to" type of building. Small cottages, with from one to six or eight private rooms, separate porches, a sitting room, and modern toilet facilities for each patient, fulfil these conditions and can be made as complete in their equipment and even as luxurious as

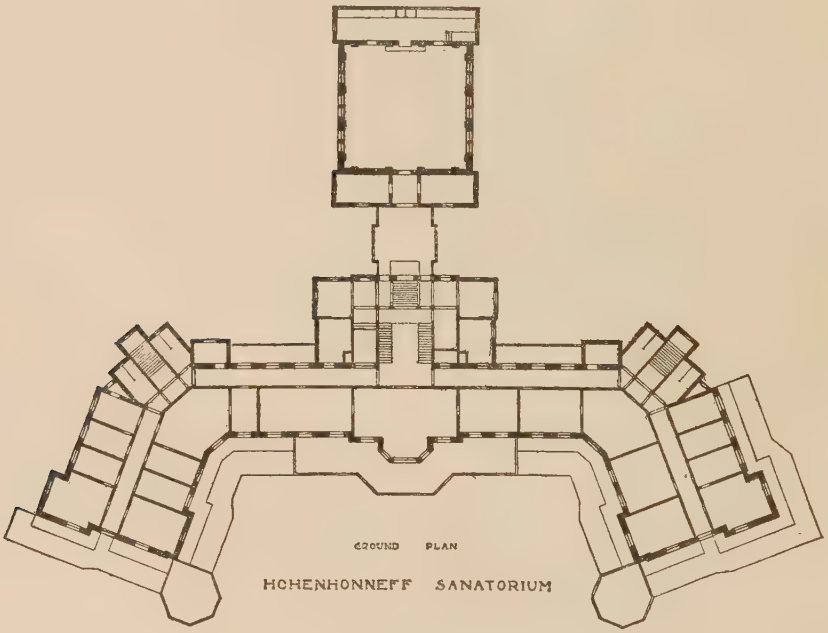

Fig. 82.—Plan of Hohenhonneff sanatorium.

the patient is willing to pay for. The meals can either be taken at the cottage or in the general dining-room in the administration building. The families or friends of the consumptive can also in some institutions obtain private cottages so as to be near their invalid, although such a plan is not advised.

There are many varieties of the cottage type of building, some of extreme simplicity and comparatively inexpensive, but eminently satisfactory so far as open-air conditions are concerned, while others are more elaborate and consequently more expensive.

The single building type of sanatorium, where the sleeping quarters and administration department are under one roof, is a type which has

Fig. 83.—Massachusetts State Consumptive Hospital (Westfield).

Fig. 84.—Adirondack Cottage Sanatorium. Main building and some of the cottages, looking west.

Fig. 85. —Loomis Sanatorium.

Fig. 86.—Eleanor Phœnix Memorial Cottage, Saranac. Adirondack Cottage Sanatorium.

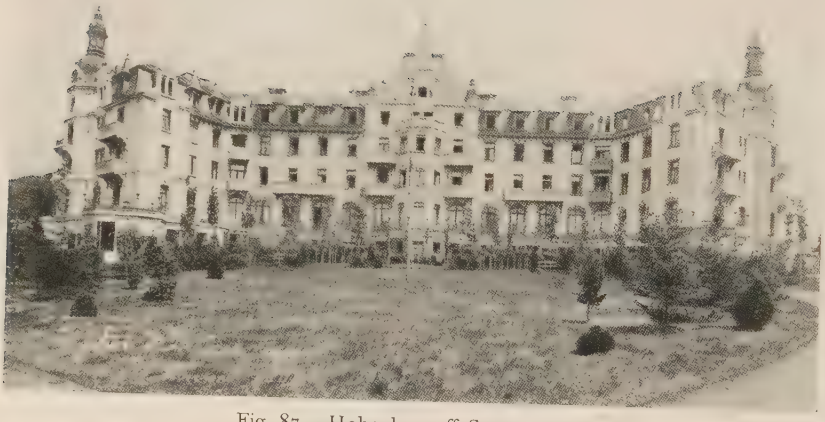

Fig. 87.—Hohenhonneff Sanatorium.

Fig. 88.—Falkenstein Sanatorium.

Fig. 89.—Sharon Sanatorium from the southwest.

Fig. 90.—Tuberculosis Hospital, Washington, D. C. Designed by Dr. George M. Kober. Frank Miles Day & Bro., Architects. Capacity, one hundred and twenty patients. Cost of construction and equipment, $100,000.

Fig. 91.—View of the Rhode Island Sanatorium (Charities).

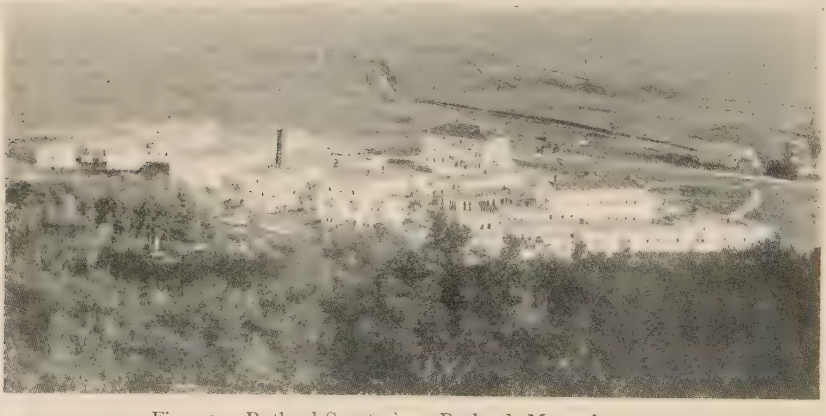

Fig. 92.—Rutland Sanatorium, Rutland, Massachusetts.

Fig. 92*a*.—"Stony Wold" Sanatorium. Southern front.

been frequently adopted in Germany (Figs. 82, 87, 88), but is not so common in this country. The advantages of this plan are the accommodation of the greatest number of patients in a small ground space, and greater ease and facility in their supervision and care as well as in the general administration. With small sanatoria, however, as the one at Sharon (Fig. 89), Massachusetts, and in tuberculosis hospitals where those in all stages of the disease are received, the single building has its advantages. The tuberculosis hospital at Washington, D. C. (Fig. 90), accommodating 120 patients, is a good illustration of the single building plan.

A modification of the single type plan is the pavilion or block system, consisting of a main or administration building, and connected with it by covered corridors, the patients' quarters in two or more buildings or pavilions of one or more stories. This plan is really but a division of the

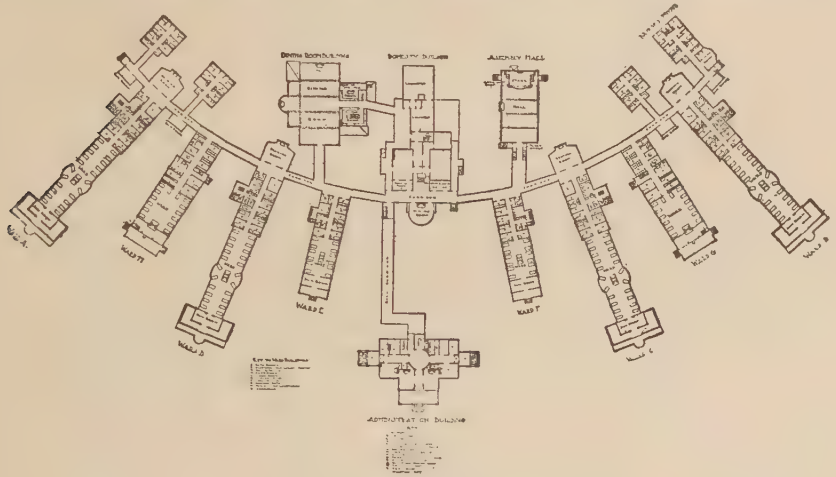

Fig. 93.—Plan of Rutland sanatorium.

single building type, separating the patients' quarters from the administration portion and yet affording facilities for close supervision.

The Rhode Island and Rutland, Massachusetts, Sanatoria in this country, and the King Edward VII. Sanatorium in England, are illustrations of this type of construction (Figs. 91–95). In both the single plan and pavilion type, whether wards or single bed-rooms are used, they must receive an abundance of pure air and sunshine and must be of such construction and furnishing as to be easily cleaned and kept clean. Furthermore, each room should afford a good view and opportunities for sleeping in the open air, which should be supplied by means of verandas or piazzas opening out of the rooms, the windows going down to the floor, so that the beds can be easily rolled out. The ventilation of the patients' quarters takes care of itself, so to speak, if they are properly constructed. Open windows, fan-lights, transoms, open fire-places, or the removal of entire side of the room, as in the Millet shack or other forms of shacks or

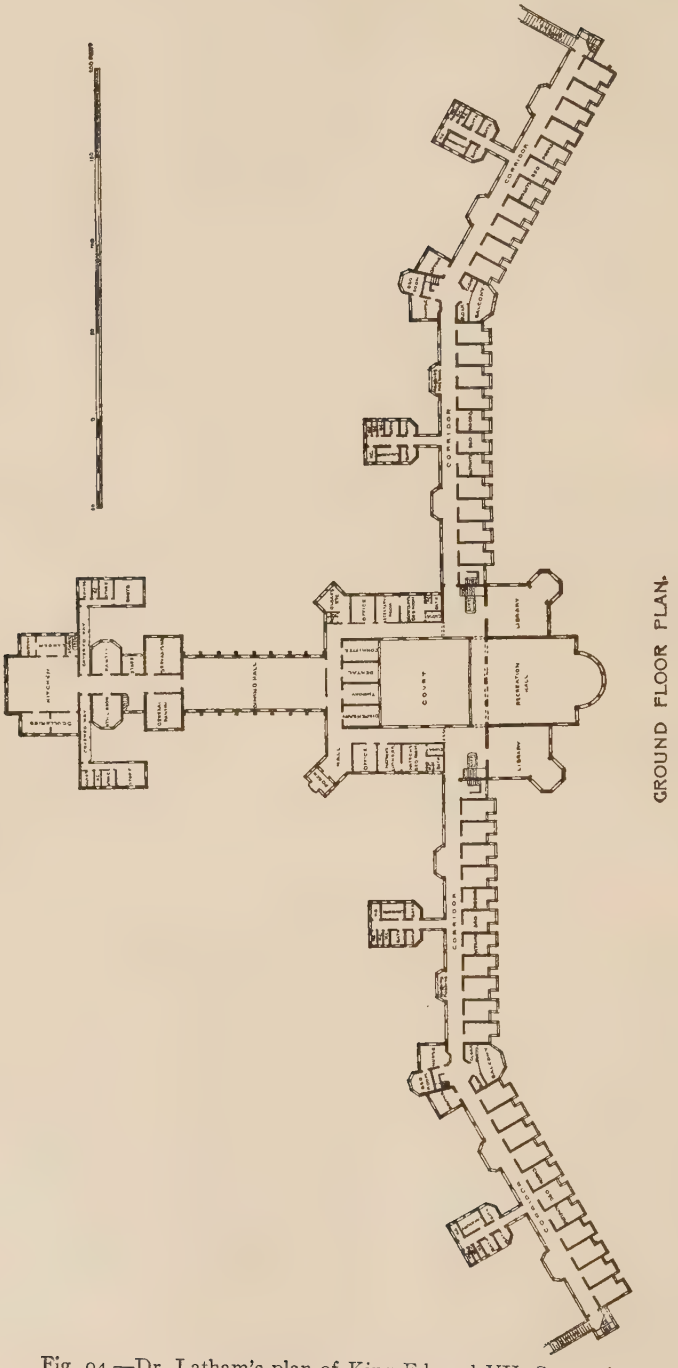

Fig. 94.—Dr. Latham's plan of King Edward VII. Sanatorium.

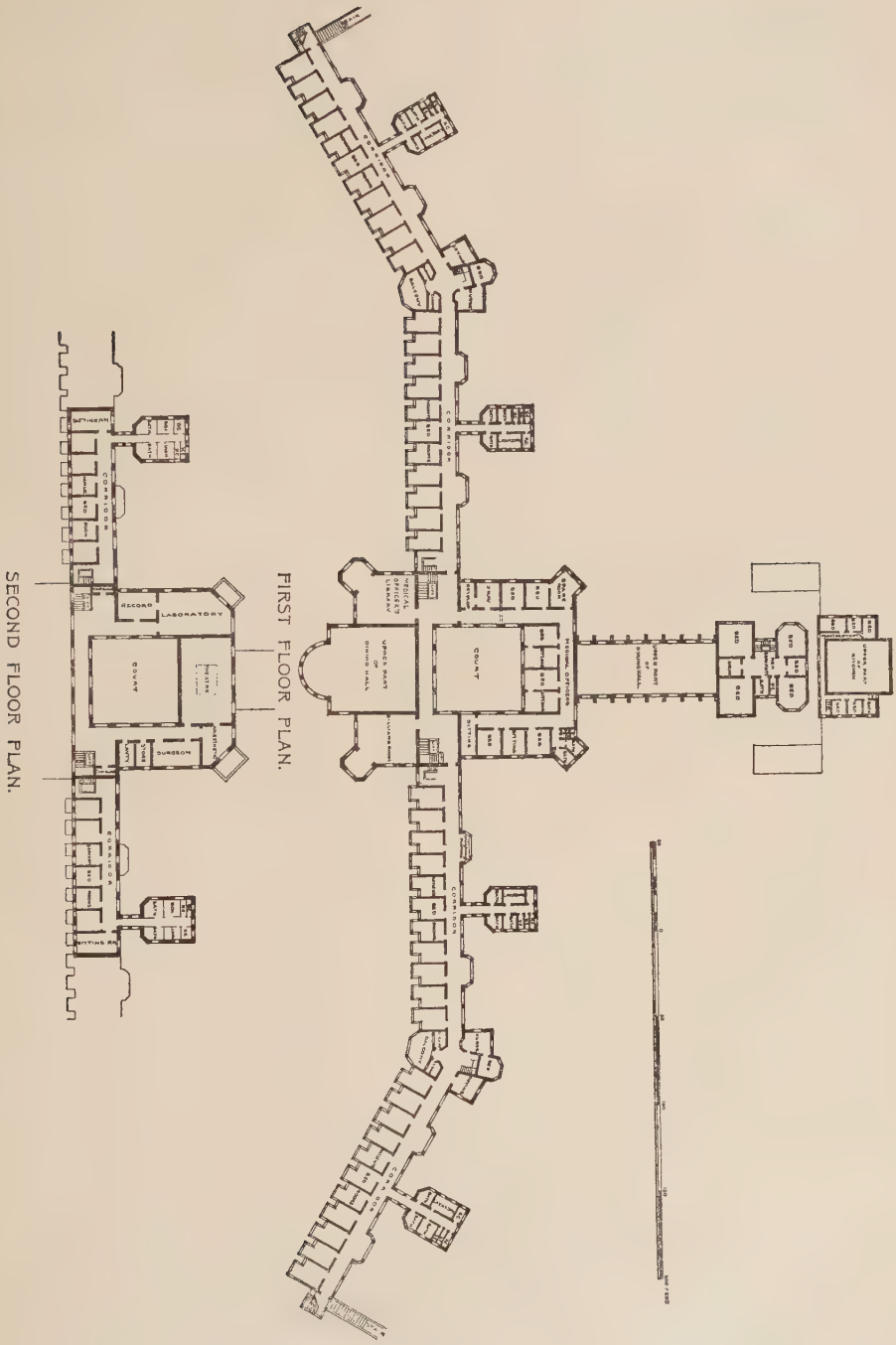

Fig. 95.—Dr. Latham's plan of King Edward VII. Sanatorium.

cottages, permit a constant change of air. In the sleeping apartments for one or more patients everything which has a tendency to accumulate dust or obstruct a free entrance of air and light is to be eliminated. There should be no carpets, curtains, hangings, or upholstered furniture. The floor should be of hard wood, or the ordinary pine floor painted or covered

Fig. 96.—Ground-floor plan of the Louise Childs Memorial Building, Adirondack Cottage Sanatorium, Saranac.

with linoleum, so that it can be easily washed, and the walls should be calcimined. All corners and sharp angles which collect dust are to be avoided. However simple or inexpensive the construction, the most approved hygienic principles must be clearly kept in view. Adequate provision must be made for the disposal of sewage and the supplying of pure water. In many large sanatoria the sewage disposal is effected by

means of the septic tank system when connection with a general sewage system cannot be made. Figs. 96 and 97 still further illustrate forms of construction.

The administration building, or group of buildings, which is the heart, so to speak, of the sanatorium, will contain the various rooms or

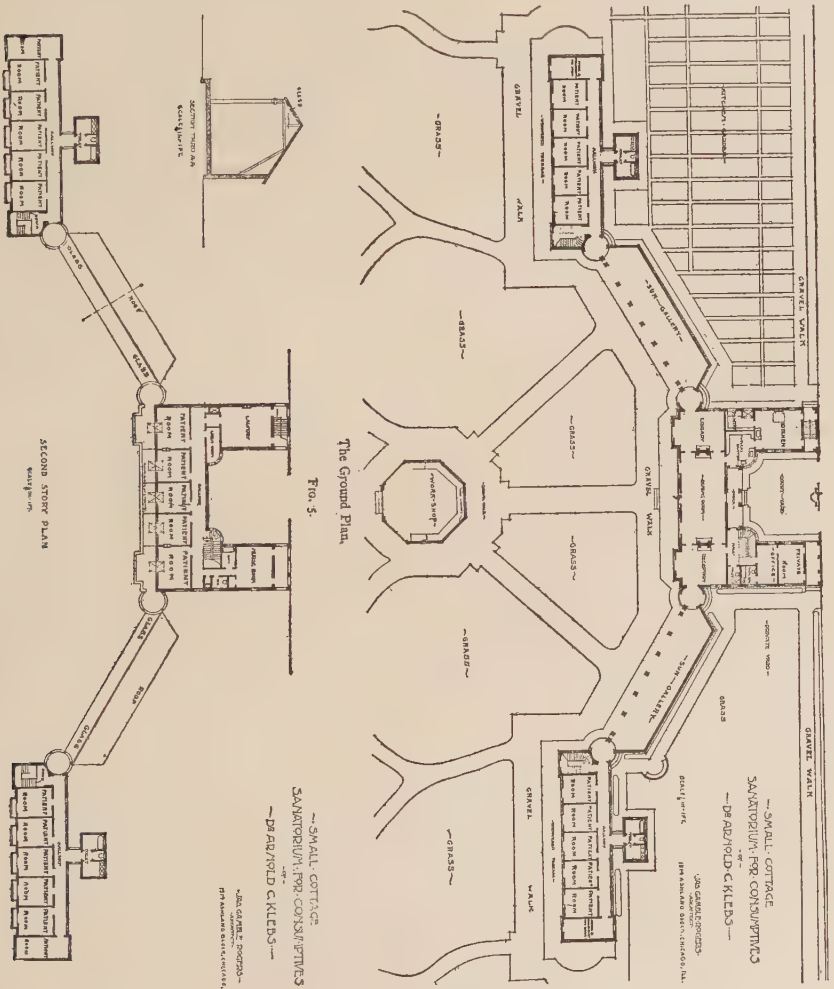

Fig. 97.—Dr. A. C. Klebs' plan of sanatorium.

sets of rooms set apart for the administration management of the institution, such as kitchen, laundry, heating apparatus, reception room, library, recreation room, physicians' offices, *x*-ray, dental, and throat rooms, laboratory, accommodations for the medical staff, nurses, and servants, various bath-rooms, and accommodations for other attachés

of the sanatorium. Of course, only an extensive institution, designed for a large number of patients, would require an administration building of such magnitude and equipment, and instead of collecting under one roof all the various departments, we may have detached buildings for the heating and electric-light apparatus, the dining-room, kitchen, laundry, laboratory, etc.

Special attention should be given to the air space and ventilation of the dining-room, where so much time, comparatively, is spent each day, and, therefore, it will be better to have a detached building surrounded on three sides by an open-air space and lighted with large windows always open, with high ceilings and a lantern or cupola ventilation. At the Nordrach Sanatorium the windows of the dining-room are entirely removed during the warmer months of the year.

Bath-rooms may be conveniently located near the wards or rooms, or each single room may be supplied, as at Nordrach, with a douche.

At Nordrach also two set basins are provided in each room, one for cleansing the mouth and teeth and the other for washing the face and hands.

The lighting of the sanatorium should be by electricity and the heating by open fire-places, low-pressure steam, or hot water.

Means of disinfecting clothing and rooms must be provided and an incinerator for burning the sputum.

An infirmary, as has been said above, is a necessary adjunct of a sanatorium, where the acute relapses, complications of the disease, or any of the intercurrent diseases can be treated by keeping the patients in bed and isolated and affording them proper nursing.

As has been said before, many circumstances will exercise a large influence upon the character of the buildings, and it probably does not make so much difference what particular form of construction or plan is adopted, provided the essential features of the treatment can be as perfectly as possible carried out.

Absolute cleanliness, and ease of maintaining it in the building, is indispensable, as well as ample means for ventilation, and every facility for leading the outdoor life in all weathers.

A kitchen department of the highest efficiency and a well-provisioned storehouse is another indispensable requisite for a successful sanatorium. "A good cook in a sanatorium ought to have a position of greater importance than the head nurse," says Klebs,[1] and it is well to recall the often quoted saying of Dettweiler, "My kitchen is my pharmacy." Most sanatoria at the present time employ a trained dietician.

Add to this, means for disinfection and the destruction of the sputum and sufficient space about the buildings for walking and exercise, and we have all the essential conditions for a successful sanatorium, provided a skilled expert is at its head.

In all that has been said above as to the location, equipment, and construction of a sanatorium, it is assumed that such an institution is

[1] Sanatoria and Hospitals for Consumptives, St. Paul Medical Journal, February, 1903.

designed for early or curable cases. Four classes of patients, says Latham, must be provided for in a sanatorium:

(1) Those who can take exercise more or less freely.

(2) Those who can take only slight exercise on level ground.

(3) Those who must be isolated in their own rooms (fever patients).

(4) Those who, unable to take exercise, may be allowed to associate with a few other patients.

Hospitals for advanced or hopeless cases are a somewhat different proposition, and their construction and management approximate more nearly to those of an ordinary hospital.

Opportunities for open-air life should, of course, be afforded, but special attention should be given to the indoor life and comfort of the patients, for the majority of them will be bedridden.

There should be connected with every large sanatorium a well-equipped laboratory for bacteriologic, pathologic, and other scientific investigations, and opportunities should be afforded for meteorologic observations.

As to the number of patients a sanatorium should contain, that again must depend upon circumstances. As a general rule, from 25 to 150 would seem to be more manageable than a larger number, although many of the German sanatoria, as well as the State institutions in this country, contain considerably more. Klebs, from his personal experience, considers that 25 patients is the maximum number one person can properly manage.

Besides a skilled physician-in-chief, there should be one or more assistant physicians, the number depending upon the size of the sanatorium, and among them one who should be the bacteriologist and pathologist. A number of nurses will also be required, but in a State or charitable institution these will be comparatively few, for most of the patients will be able to be up and about and look after themselves for the most part.

As nurses are now being employed to train and supervise private tuberculous patients taking the open-air treatment at home, the sanatorium experience is almost essential to educate a nurse for this especial work. At the present time, training-schools for nurses, with special reference to the care of tuberculous patients, have already been established in some sanatoria, and this would appear to be the only means of obtaining such instruction, since the general hospitals no longer admit cases of tuberculosis.

Some provision should be made in a sanatorium, whether it be for private patients or a public charitable institution, for the occupation of such patients as are able to take some exercise and who are well advanced toward an arrest, such, for example, as light farming, horticulture, floriculture, and various manual crafts. A manual training-school, as suggested by Klebs, is an excellent idea, and by this means a patient may acquire a craft or occupation useful to him after his discharge from the sanatorium, and in the pursuit of which he may follow an outdoor life.

At Saranac one of the older cottages has been converted into an open-air room by removing the front wall, and fitted with necessary appliances for book-binding, illuminating, and decorating by pen and in colors, and a competent instructor is employed to give instruction in these branches.

The expense of sanatorium treatment varies according to the requirements and service, as well as the number of patients treated. At the Adirondack Lodge Sanatorium at Saranac, the cost per patient per week was $12.66 for the year 1909. At the Massachusetts State Sanatorium it was $10.20 per week for the same year, and at the Rhode Island State Sanatorium, $9.86 per capita per week, also in the same year. At the Maryland State Sanatorium the cost is given as about $6.00 per week, which seems to be remarkably low. At the Sharon Sanatorium a uniform price of $5.00 is asked, which covers about one-fourth the cost of maintenance. At the Loomis Sanatorium Annex patients in the incipient stage are received, who are unable to pay more than the sum of $5.00 a week, and this probably covers the same proportion of the expense as at Sharon. At the same sanatorium other patients in the incipient stage are received for $10.00 per week, while in the regular cottages the expense is from $15.00 to $40.00 or more per week.

It is probable that a small sanatorium of 25 beds, for instance, equipped and maintained for well-to-do patients, cannot be maintained for much less than $25.00 to $30.00 per week per patient.

The reader is referred to the several authorities mentioned below for a more extensive consideration of the details of sanatorium construction:

(*a*) Sanatoria for Consumptives, F. R. Walters, M. D., London, Swan, Sohnenschein & Co., 1899.

(*b*) The Prize Essay on the Erection of the King Edward VII. Sanatorium for Consumptives, Arthur Latham, M. D., in association with A. William West, London, Balliére, Tindall and Cox, 1903.

(*c*) The Principles of Open-air Treatment of Phthisis and of Sanatorium Construction, by Arthur Ransome, M. D., London, Smith, Elder & Co., 1903.

(*d*) The King's Sanatorium, The Lancet, London, January 3, 1903.

(*e*) A Directory of Institutions and Societies Dealing with Tuberculosis in the United States and Canada, published by the Committee on the Prevention of Tuberculosis of the Charity Organization Society of the City of New York and the National Association for the Study and Prevention of Tuberculosis, New York, 1904.

(*f*) The Construction and Management of Small Cottage Sanatoria for Consumptives, by Arnold C. Klebs, The Medical News, Aug. 25, 1900.

(*g*) Country and City Cure of Consumptives; Some Methods of Housing, published by the Committee on the Prevention of Tuberculosis of the Charity Organization of the City of New York, 1905.

(*h*) Life in an Open-air Sanatorium, by Dr. Chas. Reinhardt, London, John Bale Sons & Danielson, 1900.

(*i*) Reports of Various Sanatoria, Sharon, Rutland, The Adirondacks, Loomis, and others at home and abroad.

(*j*) Some Plans and Suggestions for Housing Consumptives, published by the National Association for the Study and Prevention of Tuberculosis, 105 East 22d Street, New York, 1909.

THE HOME TREATMENT OF TUBERCULOSIS EITHER IN FAVORABLE OR UNFAVORABLE CLIMATES

By a favorable climate one refers to special climatic conditions favorable for the treatment of tuberculosis, and to the resorts or localities where these conditions exist, and in which the tuberculous individual takes up his residence for the express purpose of availing himself of their climatic advantages. By an unfavorable climate, on the contrary, reference is had to any region which is indifferent as to climate, and is not regarded as possessing any special favorable climatic factors which would entitle it to be considered a health resort for tuberculosis. In speaking of an unfavorable climate, one generally refers to that of the region at or near the patient's home. Colorado Springs or New Mexico, for example, may be taken as illustrations of the former, while many localities in the region of the large cities, in fact almost anywhere the patient may have his residence, may serve as examples of the latter. In both cases the treatment is conducted at home or privately in contradistinction to sanatorium treatment.

When one considers the enormous number of tuberculous individuals, he must realize that the vast majority of them must be treated at home if treated at all. It is probable that we shall never multiply sanatoria to such an extent that a tithe of the consumptives can be accommodated in them, even if they all desired to be. According to Osler, probably not 2 per cent. of the cases can take advantage of the sanatorium or climatic treatment.

Four divisions can roughly be made of those consumptives who must or will receive the home treatment—*i. e.*, not in special institutions:

(1) The desperately poor, the majority of whom are in the cities, but some also in the country; those who are unable to obtain entrance in a sanatorium even if one existed in their State; and, furthermore, who must work up to their physical ability for the absolute necessities of life.

(2) Those who are in more favorable circumstances while they are at work, but whose income ceases on cessation of work. Such, through the exertion of the members of the household or friends, may be able to remain at home for a time without labor, but they cannot afford the expense of a residence in a climatic resort or even that of a sanatorium.

(3) Those able pecuniarily to reside in a health resort, but who, from a strong disinclination to do so or for domestic or other reasons, are not able or do not wish to do so.

(4) Those able and willing to go to a health resort and do so, but prefer to be treated privately and not in a sanatorium, even if one existed in the resort suitable for them.

Perhaps one may add to this class also those, mostly young men, who, though without means, are enabled in one way or another to transport themselves to one of the more favorable climatic regions, like Colorado, Texas, New Mexico, southern California, etc., and there obtain some employment sufficient for their support. They do not

obtain much treatment of any kind except a life out-of-doors, but with the occasional advice of a physician they not infrequently make surprising recoveries. This may be called home treatment, conducted by the patient himself.

Each of these classes must in a measure be treated differently or, better, receive a different application, or a modification of the same broad principles of the hygienic-dietetic treatment, depending upon their environment, social and material condition, and individual character or temperament.

In all these classes it is presumed that the cases which come under treatment are in the early or curable stages of the disease. Advanced hopeless cases of whatever class can best be cared for at home or in a consumptive hospital.

In the treatment of the first class, the very poor in the city or country, many of whom are the tenement-house dwellers of our cities, much more can be done at present than was formerly the case. Every poor consumptive in our large cities can now receive a careful examination, either at a tuberculosis dispensary or a general hospital out-patient department, and be instructed in the way of the "cure," applied according to his limitations, and be kept under observation.

In many cities and towns visitors or district nurses are now employed to visit the consumptive at his home, instruct him with regard to the hygiene of his life and house and the general care of himself, and, if necessary, provide him with suitable food, and this plan can with a little pains be frequently carried out in smaller places. With patients of this class it is the writer's profound conviction, founded on dispensary experience, that our supreme efforts should be directed toward the nutrition. Patients of this class are almost invariably underfed, and what they do eat is often unwholesome and unnutritious. As Burton-Fanning asserts, "In many cases the only thing wanted to promote restoration may be the improvement of the patient's nutrition through the agency of an altered —*i. e.*, an increased—dietary."[1]

The best room in the tenement or home for air and light must be selected for the patient's bedroom, and this made and kept hygienically clean. If a possible thing, the patient should occupy it alone. Even under tenement-house conditions, more frequently than one supposes, means of sleeping out-of-doors can be devised, such as a tent-house on the roof (as is illustrated in Figs. 65, 66), or a platform outside of the sleeping-room (as shown in Fig. 98), or possibly a "shack" or "shelter" in the yard, or some form of window tent.

The instruction and training of such patients mean much, and when they once realize their danger on the one side and the possibility of a cure on the other, they become willing and fervent coöperators with the physician, and the family his eager coadjutors in taking the greatest possible advantage of all favorable conditions.

Many unhygienic conditions in the habits and environment of the patient can be avoided, and, on the other hand, limited opportunities

[1] Diet in the Treatment of Pulmonary Tuberculosis, The Practitioner, January, 1905.

Fig. 98.—Original sleeping balcony in Hanover, Massachusetts. Used since June, 1898.

a *b*

Fig. 99.—*a*, Patient from the Bellevue clinic on fire-escape; *b*, patient from the Bellevue clinic in extension chair on roof.

Fig. 100.—"Doing cure" in the yard. Henry Phipps Institute, Philadelphia, Pa.

can be utilized to the utmost. A cold bath can be taken under almost any conditions in the morning (Fig. 76); a glass of milk between meals, instead, perchance, of the glass of beer; holidays can be spent out-of-doors; crowds in unventilated rooms can be shunned, and so far as possible over-exertion, irregular eating, loss of sleep, and all other injurious habits can be avoided. In this class of cases judicious medication plays perhaps a more important part in the treatment than with patients under more favorable conditions. Tonics, such as arsenic, creosote, cod-liver oil, etc., are useful, but it should be constantly impressed upon the patient that fresh air, good food, and sufficient rest are the main reliance.

As the patient makes his regular visit to the tuberculosis dispensary or to his physician, he is weighed, his temperature taken, and a general estimate is made of his progress. From time to time, also, the visitor or nurse makes her report to the physician of the patient's home conditions and life. For this class of patients the day camp is available in many places, or the popular tuberculosis class.

If the patient is able and obliged to work he can frequently make for himself in his shop or factory, or if a housewife in her home, better hygienic conditions, when once the importance of so doing is fully realized; or possibly the work may be changed for better conditions of light, air, and cleanliness. If fever exists and rest is indicated, a serious difficulty arises. If, by any chance, the patient is able to give up his work and take a period of continued rest, this can be arranged for him on the flat roof of his house, in the brick rear yard (Figs. 99, 100), or in the country anywhere out-of-doors, as has been shown above. An inexpensive ship or canvas chair or two ordinary chairs, using one for the feet, may be used for this purpose, and while thus lying out he can be protected, if need be, from the sun and wind by an improvised awning or screen.

Even if with some temperature one is obliged to work by day, outdoor sleeping at night and all the fresh air that can be obtained by day, together with abundant nutrition, not infrequently will avail even under these adverse conditions in eventually causing a subsidence of the fever.

With the second class we have larger opportunities with which to work. If the residence is not already in the country, the suburbs of a city or in an adjacent country town, a change to a location where the residence has open space about it is possible, and in consequence the establishment of the open-air life is more readily and completely effected by many of the methods already mentioned. Moreover, sleeping in the house with open windows under such circumstances, with freer movement of air, is obviously a greater advantage over city conditions of house life.

If complete rest is indicated, either for fever or debility, one of the small shacks or shelters previously illustrated can be set up in the yard, or, as a country house generally has a piazza or porch, these may be utilized for the purpose; or, again, a second-story "sleeping-out veranda" can be constructed at a comparatively small cost. (See Figs. 23–26.)

The nutrition must receive careful attention, and a diet-list be prepared rich in proteids and fats.

It is advisable to have the patient keep a record of his daily temperature, pulse, weekly weight, amount and kind of food taken, and notes upon his various symptoms, such as cough, expectoration, sleep, appetite, etc. If no active symptoms exist, and the general condition is good, the patient, if compelled to do so, may follow certain employments under the watchful eye of his physician, making shorter hours and under favorable hygienic conditions.

Osler, in a few words, thus sums up the essentials of the home treatment in the small towns, country places, and the suburbs of our large cities, and it is so admirably expressed that it can well stand as an epitome of the home treatment in general. He says:

"First: The confidence of the patient; since confidence breeds hope.

"Second: A masterful arrangement on the part of the doctor.

"Third: Persistence. Benefit is usually a matter of months; complete arrest, a matter of years.

"Fourth: Sunshine by day; fresh air night and day.

"Fifth: Rest while there is fever.

"Sixth: Bread-stuffs and milk, meat, and eggs."

With the third class, those in easy circumstances, but who can or will not go far away from home, we are in a position to avail ourselves of everything which will make the home treatment as perfect as possible. If the residence is not in the country, a country home can be acquired, and its situation selected with direct reference to its fitness for the open-air treatment. Moreover, it can be especially equipped for this purpose, and everything made subservient to the patient's welfare.

If the patient has active symptoms, and especially if it be a woman or child, the employment of a nurse experienced in the treatment, at least at the beginning, is strongly advised.

The constant supervision and education in the detail of the "cure' through a trained nurse is invaluable; and the physician is kept informed of the progress of the disease with a minuteness not otherwise possible. Moreover, the companionship and encouragement of an agreeable and inspiring nurse is of no small value, and, furthermore, she will insist that the nourishment is properly prepared and taken in sufficient quantities.

It is frequently possible, and often wise, to send a patient of this class for a brief period to a sanatorium that the plan of the hygienic life may be thoroughly learned. No amount of teaching will accomplish this so well as doing it and seeing others do it about one.

The "rest cure" by day and the open-air sleeping by night can be satisfactorily arranged for by a "shelter," shack, or piazza facing south, southeast, or southwest, and, if needed, protection from the wind may be secured by a movable awning, screen, or similar device. If the piazza or veranda opens out of the patient's room, and a low window or door will permit of it, the bed can easily be moved out in the open air, even if the patient has fever. If a room is used for sleeping, it must

be large, so as to afford a sufficient air space, provided with large and numerous windows, and an open fireplace. The furnishings should be few and plain, and capable of easy removal and cleansing.

It is not necessary, however, to convert a room, as Minor says, into a "species of cell with four bare walls, a bed, and a chair." The bed stands out in the room, so that good circulation of air may be secured. If, in addition to the open fireplace, furnace heat is required, as is commonly the case in our northern latitudes, a porous pot of water, before referred to, may be hung under the register, and the dry furnace air can thus be moistened as it enters the room, giving it a more natural and agreeable atmosphere.

The bed-covering should consist of blankets or light material, and only as much as will keep the patient comfortable.

A reclining chair well upholstered (see Figs. 49, 50, 51, 52) is the best device for taking the open-air rest "cure," for the recumbent position has been found to be the most favorable one, and, of course, complete rest is indicated when fever is present. If, on the contrary, the patient is afebrile, a walk once or twice a day from one-half to two hours may be taken, the extent depending upon the temperature. If the temperature rises and remains up any length of time after the walk, it either must be shortened or discontinued. While lying in the reclining chair the patient can read any unexciting literature; engage in some simple handiwork, such as basket-weaving, carving, etc., or if he is fortunate enough to have a pleasing landscape before him, enjoy the view. Much talking and visiting is generally a useless expenditure of strength.

In the patient's bedroom, or an adjacent bath-room which is warm, the cold morning sponge-bath can be taken.

The physician who has his patient under the care of a nurse, or who has trained him to keep a record of his own case, may, when the disease is progressing favorably, find that a visit once in several days is sufficient. This, however, will depend upon the state and activity of the disease, as well as upon the character of the patient. Frequent visits may be deemed advisable, simply to inspire and encourage him.

When the home treatment has been fully established, and the necessary equipment installed, a detailed program or daily routine should be written out, subject to such modifications as changes in the condition of the individual or the disease indicate. A suggestive day's routine for the average patient whose general condition is favorable, and who is afebrile, is again repeated here for the sake of completeness.

In the morning on rising the patient takes a glass of hot milk, bouillon, or a cup of weak coffee with cream; then he takes a cool or cold sponge-bath in a warm room, and dresses.

7.30 to 8.30 A. M.—Breakfast, consisting of weak tea, coffee, or milk; a cereal with cream and sugar; fried bacon; a poached or boiled egg; bread and butter. For the egg may be substituted a chop, steak, minced meat, sweetbreads, chicken, fish, etc. After breakfast rest until exercise, if ordered.

9 to 11 or 12 A. M.—Exercise when permissible, generally a measured walk, resting at the limit before returning.

11 A. M.—A glass of milk or malted milk, oatmeal gruel, bouillon, or raw egg. (These and the other between-meal nourishments may be omitted if the patient is in a good condition and takes three good meals a day.)

12 to 1 P. M.—Rest in a reclining position.

1 to 2 P. M.—Dinner, consisting of soup, rare roast beef, mutton, lamb, or fowl; vegetables, such as potatoes, spinach, tomatoes, peas, beans, corn, asparagus, etc.; salad with olive oil dressing; a simple dessert; fruit and, if desired, a small cup of black coffee. After dinner rest for one-half hour or more.

3 to 4 or 5 P. M.—Exercise if permissible—generally a walk.

4 P. M.—Milk with cracker or bread and butter, bouillon, milk, or malted milk, or a raw egg or egg lemonade.

5 to 6 or 7 P. M.—Rest in a recumbent position.

6 to 7 P. M.—Supper. One warm dish, meat, fowl, or minced meat; boiled rice, a cereal, bread and butter, tea or cocoa; cooked fruit or marmalade. After supper rest on the piazza or in a room with the windows open.

9 P. M.—A glass of warm milk, bouillon, malted milk, or Mellin's food.

9.30 to 10 P. M.—Retire.

The patient can either take his meals with the family or, in some instances, alone out-of-doors, remaining in his reclining position if, for any reason, such as a tendency to vomiting, this is considered preferable.

The temperature should be taken twice or three times a day, unless it has been normal for a considerable time.

The time not occupied by eating, exercise, or other prescribed duties is to be spent in the reclining chair out-of-doors.

After each meal the mouth and teeth should be thoroughly cleansed—the integrity of the digestive process depends so much upon the good condition of the teeth.

It goes without saying that the most painstaking care should be taken in the proper destruction of the sputum, and whatever is used by the patient—his bedclothes, eating utensils—must be reserved for him alone and separately cleansed. Once a week also the bedroom must be thoroughly cleaned.

Mental quietude and cheerful expectancy are to be cultivated in the patient, and herein the personality of the physician means much, as has already been insisted upon. The physician must, as has been said before, be schoolmaster and inspirer, as well as clinician, and cultivate in his patient "A merry heart which maketh a cheerful countenance and doeth good like a medicine."

With the fourth class we have a new set of conditions to deal with; namely, the home treatment in a new climate. Old associations, old habits, the accustomed environment, are all changed for new scenes, new habits, and unaccustomed surroundings. Indeed, one of the benefits of a radical change is that old habits of life are broken up and new ones substituted. No radical change of this kind is to be unad-

visedly or lightly entered upon, but discreetly, soberly, and advisedly; and yet, even to this day, one often finds patients sent far afield in the most haphazard way. Perhaps most frequently the patient goes on his own responsibility or on the advice of friends, and the physician is in no way responsible.

In determining the question of a change of climate, the principal points to be considered can again be briefly repeated:

First: The exact condition of the patient and his disease.

Second: The climate best suited to him and his disease.

Third: The sanitary condition of the resort selected; the accommodations; possibilities of obtaining good food, and of finding a reliable local physician.

Fourth: The influence of the change and climate upon the relatives or friends who will accompany the patient.

Fifth: The material or pecuniary condition of the patient. Can he conveniently afford to make a long sojourn from home without pecuniary worry?

When once, however, the resort which seems most suitable for the case has been selected, the name and address of a reliable local physician are to be obtained, and he should previously be communicated with and given an outline of the case. He also will advise as to the selection of accommodations, and these should be secured beforehand.

It is to be borne in mind that at the present time in very many health resorts neither hotels nor boarding-houses will receive tuberculous cases, and hence the importance of determining beforehand the matter of accommodations. Often the local physician controls one or more boarding-houses which are exclusively used for tuberculous cases, or if not, one may be obliged to establish housekeeping. The ideal arrangement is a house to one's self, with a good cook and service, and conducted with a view to the sole welfare of the patient, with the medical supervision of a sanatorium expert, if such an institution happens to exist in the resort, as at Saranac, for example.

On arriving at the resort the local physician should at once be visited by the patient, and from that time henceforth the patient should be under his immediate care and control. Any attempt of the home physician to control or direct the treatment at a distance is pernicious—it is neither just to the patient nor reflects any credit on the home physician.

When once the patient is established in his new home, the daily routine and treatment will be the general hygienic-dietetic open-air one, as has been described under the third class, modified according to the resort and its special climate.

One is referred to the admirable exposition of this home treatment in a favorable climate to Minor, of Asheville,[1] and also to Gardiner, of Colorado Springs.[2]

[1] On the Feasibility and Management of Hygienic Cure of Pulmonary Tuberculosis Outside of Closed Sanatoria, by Chas. L. Minor, M. D., New York Med. Jour., Dec. 21, 1901, and January 11, 1902; Hints and Helps for the Consumptive, Minor, Asheville.

[2] The Care of the Consumptive, G. P. Putnam's Sons, 1900.

Of course, the weak point in the open-resort treatment is the ever-present danger that the patient will not keep himself strictly under the constant supervision of the physician, especially when he finds himself improving, and the latter does not possess the same power of compelling obedience which the sanatorium physician does. The sanatorium patient is like the soldier of the regular army, obliged ever to obey unquestionably his superior officer, while the open-resort patient is like the militiaman, over whom his superior officer has but a partial and intermittent control.

Whether or not, however, we admit that any home treatment, even at its best, can equal that of a well-conducted sanatorium, we have to accept the fact, as has been said, that the great mass of consumptives, at least in America, will and must be home treated, and, consequently, it is the part of wisdom to perfect and develop the home treatment so that we may obtain from it the best possible results.

In the matter of drugs and medicines in the home treatment and in the treatment of special symptoms, the reader is referred to a later section.

CLIMATE AND CLIMATIC RESORTS IN THE TREATMENT OF TUBERCULOSIS

Before the infectious nature of tuberculosis was discovered, and before the present hopeful view of its curability was entertained, or, indeed, before an early diagnosis was made as often as it is now, a change of climate was generally regarded rather as a palliative than a curative measure. To prolong life and render existence more endurable and comfortable was generally all that one expected from a change of climate. Consequently, a climatic resort was chosen which would fulfil these conditions, and this resort generally possessed a moist, warm, equable climate, as Florida, the West Indies, or various islands in low latitudes, and such resorts did, in many instances, accomplish to quite an admirable degree the object for which they were visited, and sometimes even more, for the outdoor life under sunny skies and the warm, agreeable atmosphere did doubtless occasionally produce, if not an arrest, a quiescent condition of the disease, by which means life was indefinitely prolonged and one was enabled to pursue his usual activities to a certain degree and with a certain measure of comfort. Moreover, one of the main points kept in view when a change of climate was contemplated was the influence it would have upon the local condition, especially upon the cough. Now a climate is sought for the improvement it will exercise upon the general condition and nutrition; for, if this object is accomplished, the cough and other symptoms will generally take care of themselves.

With regard to the exact place climate should hold in the therapy of tuberculosis there exists a variety of opinions. One extreme values climate only as a means of obtaining pure fresh air and lays little or no stress upon other climatic elements. The other extreme looks upon

climate as the fundamental principle in the treatment and other means rather as accessories. The real truth, as in most other contentions, lies between the two extremes. Whereas tuberculosis in its curable stage is susceptible of arrest or cure in any climate where pure air is obtainable, it is fair to assume, from such knowledge of climate and its influences as we already possess, that the cure is materially aided by conducting it under favorable climatic conditions.

Other things being equal, granting the presence of the usual and necessary surroundings, such as reliable and skilful medical supervision, proper accommodations and good food, efficient hygienic and sanitary conditions, proper equipment for the open-air life, and the advantage in conducting the treatment lies with the more favorable climate. A sanatorium in Colorado, New Mexico, Arizona, or some portions of southern California, for example, conducted under the same rigid and skilful direction as are the best of such institutions in the East or in Germany, would, in the writer's opinion, either show a greater percentage of arrests of the disease, or if not this, accomplish equal results with greater certainty and comfort to the patient. Furthermore, individual cases which, under the best treatment in what we would regard as less favorable climates, do not improve, do so and go on to arrest in one of the climates which are considered as more favorable. It is also a fact that the reverse of this has been found to be true. A patient doing badly in Colorado, for instance, will begin to improve when a change is made to the Adirondacks or some other eastern resort. But the writer's belief is that the improvement is likely to occur more frequently when the change is made to a climate which is regarded as one of the more favorable ones.

What, now, are the essential elements for a favorable climate in the treatment of tuberculosis? (And be it understood at the outset that there is no such thing as a specific climate; in the present state of our knowledge we can only say that certain climates appear to be more suitable or beneficial for the treatment of tuberculosis than others, although some able phthisiotherapeutists even deny this, and the only demand they make is for pure air wherever it may be found and such conditions as will permit the patient to spend the whole or the greater part of his time in the open air.) Pure aseptic air is the first and most important element, and pure cool air rather than pure warm air. But there are other elements also of value—sunshine in abundance or, at least, a fair amount of it, is obviously desirable. Sunlight purifies the air; it is inhibitive and destructive to microörganisms, it exercises a stimulating effect on the skin, and has an exhilarating influence upon the mind. The Italian under his sunny skies is a more cheerful and happier individual than is his Swiss neighbor on the other side of the Alps.

Another important requisite in the climatic resort is freedom from dust, for dust is irritating to the delicate mucous membrane of the respiratory passages. Freedom, also, from high winds is generally regarded as an important requisite in a climate, although King, physician in-chief of the Loomis Sanatorium, declares himself in favor of wind

in a resort for phthisical patients.[1] "The purifying and invigorating effects of strong, cool, and dry wind in a pure air," he says, "cannot be overestimated. It secures ventilation of buildings and apartments much better than any artificial device can do." Furthermore, he has not noticed "that it ever increases liability to colds or aggravates catarrhal conditions of the respiratory mucous membrane." One thing must be remembered, that with a dry, sandy soil wind makes dust, and dust, by its mechanical effect, does irritate the respiratory passages. While exposure to a cool, quiet atmosphere may be without discomfort, with wind the same temperature becomes exceedingly uncomfortable and trying, if not unendurable. The low temperature of the Alpine winter resorts, as at Davos, Arosa, and others, would hardly permit the free open-air life now practised there if there was any large amount of wind.

Another favorable element is relative dryness of the air, as indicated by a low relative humidity. Again, there is a diversity of opinion regarding the value of this element, but the favorable results obtained in the resorts of the desert, in the arid regions of Arizona, New Mexico, Texas, Colorado, the inland regions of southern California, and some portions of the Pine Belt of the South, as well as in the altitudes, would seem to prove that there is more or less virtue in a dry atmosphere. Solly reminds us, however,[2] that the accompanying factors of a dry atmosphere—namely, more powerful sunlight and heat, less depressing cloudy weather, cooler nights and shade, greater opportunity for exercising and resting in the open air, and the free access of fresh air to the house by day and night—must have some share of the credit in the beneficial influence ascribed to dryness of air. The local effects often observed in a dry atmosphere are the diminution of cough and expectoration. On the contrary, it is also a fact that a life on the ocean, where the atmosphere is saturated with moisture, is favorable for those already suffering from tuberculosis, while those whose occupation is upon the sea are particularly free from it; as, for instance, fishermen, who show a very low death-rate from respiratory diseases

It is to be borne in mind that a dry climate is not an equable one. An atmosphere heavy with moisture conduces to equability, and this is enhanced by warmth, so that the most equable climate is found in low latitudes, on the ocean, on islands, or the coast. Marine climates are the equable ones, and are characterized by a small annual and diurnal range of temperature. The greater the distance from the ocean, the greater the range of temperature and the drier the atmosphere, unless local influences interfere.

In dry climates the difference between the day and night temperature is marked, the most so on deserts, where one may have frost at night and a temperature of nearly 90° F. by day. The dry atmosphere forms a favorable medium for the radiation of heat from the earth's surface, which has become highly charged with heat during the day by

[1] The Sanatorium Treatment for Tuberculosis, by Herbert Maxon King, Medical News, July 4–11, 1903.

[2] Medical Climatology, 1897, p. 86.

the intense insolation. Hence, in a very dry climate the patient must exercise great caution at sundown, whether it be in the altitudes of Colorado or the Egyptian desert.

The element of equability in a climate, with the conditions under which it exists, is not of value or even desirable in the hopeful treatment of pulmonary tuberculosis; that is, in the early cases. As a palliative, however, as has been above mentioned, it has its value, and may be a necessity when disease exists in other organs.

"The quality of equability in a climate," says Yeo,[1] "was at one time greatly overrated. Indeed, we, nowadays, avoid an equable climate when seeking a cure for early cases of pulmonary tuberculosis We rather seek a climate with a very wide diurnal range of temperature, if it is a dry climate, as the Engadine or Egypt.' Wide diurnal variations of temperature exert a bracing, invigorating tonic effect, especially where they follow a certain regularity. What renders our own climate (England, also applicable to many parts of America) so very trying at times is that, although very variable, the variations of temperature follow no regularity."

"Dry climates," says Huggard,[2] "are never equable in temperature, though they may be regular, I do not say equable, in their heat demands."

What influence mere temperature—a warm or a cold climate—exerts upon tuberculosis it is difficult to say. Probably it makes no very great difference, provided other favorable climatic conditions exist. A medium or cool temperature is, however, considered the most beneficial, as it is more invigorating. In respect to temperature, individual conditions and idiosyncrasies are, to a certain extent, to be consulted. One person, for example, seems to evince both a psychic and a physical antipathy to the cold, and thrives best and is more contented in mind in a moderately warm climate. Another person, with no greater apparent constitutional vigor, responds more readily to treatment and feels better in a colder climate. Cold, *per se*, has no especial value as a climatic element, although such was formerly thought to be the case, and Canada and Minnesota were at one time popular resorts for consumptives.

In any study of climate, the character of the soil deserves some consideration. How much of a contributory factor, however, in the causation of tuberculosis a damp soil is, it is at present a doubtful question. It has usually been supposed that a damp soil is prejudicial to the successful treatment of tuberculosis, and, in fact, was conducive to the development of the disease. However this may be, it is preferable that a climatic resort should possess a dry, sandy, porous soil.

When we come to the consideration of altitude, a new climatic element comes into play; namely, diminished barometric pressure—the air is attenuated, rarefied; moreover, it is supposed to be more sterile than the air of the plains. In fact, experiments of Tyndall and others have proved it to be so. Its diathermancy is greater. As to the exact in-

[1] Transactions of the British Congress on Tuberculosis, vol. iii, p. 19, 1901.
[2] Ibid., p. 29, 1901.

fluence of altitude in itself upon tuberculosis, opinions are varied and conflicting. Phillips, an authority in this country on medical climatology, considers that whatever virtue there is in elevated sanatoria for tuberculosis "flows from the absence of clouds, and is due to the effects of the intense insolation under low temperatures that favor life passed in the direct sunlight rather than in the shade."[1] Some authorities attribute to the diminished barometric pressure an especial beneficial influence upon the circulation and respiration, an increased hematogenesis, and enlarged respiratory capacity. Others, like Phillips, look upon altitude as affording only excellent opportunities for obtaining pure fresh air and abundant sunshine. Practically it does not make very much difference what is the truth among the variety of opinions, and, indeed, probably the truth is not yet known. We do know, however, that the climate of altitudes in the treatment of tuberculosis has produced exceedingly good results, and the consensus of opinion to-day among phthisiotherapeutists seems to be in favor of the altitude over the sea-level resorts. E. von Leyden declares that he is of the opinion that the best results are obtained in the high-altitude climates,[2] and Hermann Weber, C. Theodore Williams, Knight, Solly, and others concur in this opinion.

One must always bear in mind, however, as Cornet so well says, in considering climate in general, be it elevated or low land, that "the essential factor is the amount of time which any given climate permits the patient to spend in the open air," and, furthermore, that no one kind of climate, however many favorable elements it may possess, is adapted for all cases or all individuals. So far as our present knowledge of climate enables us to do so, we must select the climate which seems to be best adapted to the particular individual, after carefully taking into consideration all the conditions of his especial case.

What, now, are the beneficial results which we are to expect from a suitable climate? Essentially those which ensue from an open-air life, and, in addition, such further benefit—how much or how little is yet undetermined—as may be produced by the favorable climatic factors just discussed, such as pureness and dryness of air, temperature, diminished barometric pressure, and constant sunshine. The whole organism is stimulated; the circulation and nutrition are improved; the nervous tone is raised; the ventilation of the lungs is more complete—they obtain a better and more abundant supply of oxygen through an unlimited and constant access to pure fresh air; bacterial activity is diminished, as indicated by the subsidence of fever; muscular energy is augmented, and the mental condition improved. Of course, all this favorably influences the local conditions in an indirect way. What influence climate exercises upon the local lesion we do not know—probably only a negative one, by improving the environment. In the mixed infection—and who shall say when it is not such?—if an environment of sterile air furnishes no more of the various microörganisms found in

[1] Reference Handbook of the Medical Sciences, 1891, vol. iii, p. 147.
[2] Ueber den gegenwartigen Stand der Behandlung Tuberculöser, Berlin, 1897.

this stage, those already at the seat of infection become attenuated and harmless, and may not this be the explanation of the disappearance of the fever and other septic symptoms during the open-air treatment?

Yeo, in his enumeration of the objects of treatment by climate, mentions the arrest of catarrhal conditions of the air-passages, which, in a way, may be considered a direct influence of climate.[1]

Of course, the question naturally arises, Will not all these beneficial results follow, and are they not to be hoped for, from the open-air life in any climate? We must answer, yes, to a greater or less degree, but from the evidence so far in our possession we can more surely and perhaps more speedily acquire these benefits by the open-air life in one of the more favorable climates. Such seems to be a fair estimate of the value of climate in the treatment of tuberculosis.

Schröder,[2] after a consideration of various climates and their characteristics, thus concludes: "There are climatic factors of great value in the treatment of tuberculosis which are found on the sea or its borders, inland, and in the mountains. There is, however, no specific climate for tuberculosis, and in every climate of the temperate zone we can find helpful influences in our treatment. In sending patients to the sea or mountain resorts, careful individualization of patients is requisite. Every physician should realize that nothing can work greater harm to the consumptive than an unreasoning adherence to the idea that climate can exercise a specific influence upon tuberculosis."

Dettweiler, the great German authority, says:[3] "A specific or a truly immune climate does not exist. The value of a climate depends upon how perfectly it can aid in the production of improved nutrition and a restoration of all functions to a normal physiologic standard, working both through the body and the mind to accomplish this. Phthisis can be cured in every climate where extremes do not exist. The individual condition of the patient alone determines the choice. To accomplish a cure, the plan of treatment and the method of life the patient follows hold the first consideration."

This question of the value of climate is further complicated by the varied conditions and stages of the local disease and the condition of the individual himself, his antecedents, race, age, habits, temperament, previous occupation, condition of other organs, will power, and social and pecuniary state. For example, a young man of originally good constitution, and with considerable vigor remaining, with limited local disease which is of slight activity, is likely to obtain an arrest or cure of his disease almost anywhere under judicious medical supervision, but, in the writer's opinion, his chances are enhanced if this life is followed in a cool, dry climate, like that of the altitudes. Another case of less constitutional vigor and resisting power, and with more extensive local involvement, may do better in some of the aseptic climates of the sea-level.

[1] Transactions of the British Congress on Tuberculosis, vol. iii, p. 15, 1901.
[2] Handbuch der Therapie der chronischen Lungenschwindsucht, p. 419, Leipzig, 1904.
[3] Die Therapie der Phthisis, Wiesbaden, 1887.

Still another question which comes up for consideration is whether patients are to be sent to a climate differing widely from their home climate or the one they are likely to live under in their subsequent life. Although there is a difference of opinion on this question, yet there seems to be no reason why a patient who has made a good recovery should not be able to live in any climate which is not extreme if he observes the precautions necessary for all cured consumptives.

In the classification of climates two general divisions are usually made: First, marine climates (those of the ocean, islands, and sea-coast); second, inland climates (low-lying, medium, and high altitudes).

Under marine climates are included the sea itself, islands, and sea-coast resorts, which, from their position and the direction of the prevailing winds from the sea, possess to a greater or less degree marine climatic characteristics. Coasts with large deserts or arid plains lying adjacent, with a prevailing wind from the land, often lose their marine climatic characteristics and partake of those of the contiguous deserts or plains.

Marine climates are moist and equable. Those in the more southerly latitudes, as on the Atlantic or Gulf coast of the East, or on the Pacific in southern California, offer a moist, sedative climate. Those in the southeast may be considered as palliative climates, and do not exercise the stimulant effect which is considered desirable in the curative treatment of tuberculosis. Such, for example, are Nassau, Jamaica, Bermuda, and others of the West India Islands; St. Augustine, Jacksonville, Palm Beach, and many other southern coast resorts, or the islands of Madeira, the Canaries, and many of the coast towns on the Mediterranean.

The coast of southern California presents certain different climatic characteristics from those of the eastern coast region of the United States. The average temperature is lower, the monthly and seasonal variations are small, and the configuration and character of the plains and adjacent mountains render the atmosphere somewhat drier. According to Lindsay:[1] "The driest marine resorts in the world are those upon the Californian coast." There is no excessively debilitating heat and the sunshine is almost continuous. At night it is usually damp, and the air is chilly after sunset and in the shade and when the wind blows. Many consumptives apparently do well in this climate, and Santa Barbara, San Diego, Los Angeles, and Pasadena, which latter town is ten miles inland, are well-known resorts of this coast region and offer good accommodations. The chief characteristics, then, of this climate are mildness, sunshine and equability, and its availability throughout the year. It is less sedative and rather more stimulating than the island resorts of the southern Atlantic and Gulf coasts.

The southern coast of England furnishes many seashore sanatoria considered of value in the treatment of tuberculosis, and all of them afford comfortable accommodations. Such are Ventnor, on the south shore of the Isle of Wight, Bournemouth in the Pines, Torquay, Penzance, and others.

[1] Climatic Treatment of Consumption, 1887.

On the Mediterranean coast is the famed Riviera, with its comparatively mild, sunny winter climate. This region is visited by hundreds of consumptives from all over Europe as well as from America. The Riviera climate is not, however, in the writer's opinion, equal to that of southern California, with which it may be compared. The frequent north wind, or "mistral," is strong and harsh, the temperature range is large, the seasons are uncertain, there is less sunshine, and the climate can only be utilized during the colder portions of the year. The scenery, however, is exceedingly attractive and the accommodations excellent. Arcachon, on the coast of France, ten miles from the sea, enjoys considerable reputation as a resort for the tuberculous. It is situated on sand dunes in the midst of pines, and has a mild, equable winter climate.

Professor Gram, of Copenhagen,[1] believes that most—probably all—cases of pulmonary tuberculosis could be treated successfully at the seashore. If pure air and conditions rendering it available are the chief requisites of a sanatorium for tuberculosis, then this conviction of Professor Gram may be true, but the writer believes that inland and mountain resorts are preferable and more beneficial than seaside resorts.

When the tuberculous lesion occurs in the young or elderly, and in those with other diseased organs or conditions, such as cardiac, renal, or glandular disease, or bronchial, emphysematous, or rheumatic complications, the equable and mild seaside resorts, like those of southern California, are of much value. Early cases of tuberculosis also are favorably influenced by the southern Californian coast climate, while more advanced cases of tuberculosis with but little vitality often prolong life and live more comfortably in the warm, moist, equable seashore resorts of the Atlantic and Gulf coasts and in the islands of the warm latitudes.

Ocean voyages for tuberculosis, once in much vogue with the English phthisiotherapeutists, are now rarely advised. The air of the ocean is of great purity, it is true, but the obvious difficulties and disadvantages of an ocean voyage render this method of obtaining the pure air far inferior to favorable climatic resorts on land.

Inland climates are of many varieties, depending upon the latitude, elevation, temperature, and moisture. In the United States, inland resorts possessing more or less reputation in the curative climatic treatment of tuberculosis may be divided, according to elevation, into low, medium (up to 1500 ft.), and high altitude (from 4500 ft. up) climates, andl according to temperature and humidity, into warm dry, moderately coo' dry, and moderately moist cool. In the East we have the Adirondack region of moderate elevation (600 to 1800 ft.), and possessing a cold, dry winter climate and a moist, cool summer one. Saranac is the best known of the many resorts in this section, and, through the marvelous work of Dr. Trudeau of the Adirondack Lodge Sanatorium, has proved the value of a climate of this character in the treatment of tuberculosis. A similar climate and resort is at Liberty (2300 ft.), New York, with its

[1] Transactions of the British Congress on Tuberculosis, vol. iii, p. 32, 1901.

well-known Loomis Sanatorium. Asheville (2250 ft.), North Carolina, is another eastern resort of medium elevation, and possesses a moderately cool, dry, very sunny climate. Like Saranac, it is available for treatment throughout the year. The Pine Belt of New Jersey, the principal resort of which is Lakewood, offers a pure, cool atmosphere, of moderate moisture, and possesses a sandy soil. Lakewood itself affords excellent accommodations, but is used chiefly as a winter resort.

There are many other localities in the east—in Pennsylvania, New Hampshire, Vermont, and Massachusetts—possessing a moderately cool, moist climate. Most of them, however, are available only in the summer. In the central highland portion of Massachusetts is the well-known resort of Rutland, offering all the year round accommodations for tuberculous patients. Here is situated the Massachusetts State Sanatorium for consumption. Various sections of the Middle West also afford favorable resorts of low or medium altitude.

The Southern Pine Belt region of the United States, embracing portions of North Carolina, South Carolina, and Georgia, possesses climatic characteristics quite similar throughout its extent, consisting of more or less dryness, pureness of air, abundant sunshine, and a dry, sandy soil. This region has little if any elevation. Aiken, Camden, Summerville, South Carolina, Thomasville and Augusta, Georgia, are some of the best-known resorts. They are available only in the colder months of the year, which in many cases is a decided disadvantage.

In the southwestern and Rocky Mountain region of the United States are found the resorts of high altitude as well as those of low or medium elevation. The latter possess a dry, warm climate with a large amount of sunshine. In Arizona are the well-known resorts of Phœnix Tucson, and Yuma, the latter situated in the great Arizona Desert, and possessing a particularly mild and dry climate. All these places are of low or medium elevation. In Texas resorts of similar climatic characteristics are San Antonio, San Angelo, and Boerne. In the eastern foothills of southern California is a region fifty or more miles from the coast which offers excellent climatic conditions for the treatment of tuberculosis. Here are situated the resorts of Redlands, Riverside, and others. There is almost perpetual sunshine, the winter climate is mild, the air comparatively dry, and the annual rainfall small.

In Colorado, New Mexico, and portions of Arizona and Texas are many high altitude resorts, ranging from 4000 to 7000 feet high, differing in average annual temperature according to latitude. Colorado Springs, Denver, Boulder, Manitou, and Estes Park are some of the resorts in Colorado whose climatic characteristics are a fairly cold winter, cool summer clear and dry atmosphere, and abundant sunshine. Las Vegas, Santa Fé, Albuquerque, Fort Bayard, and Silver City are some in New Mexico. El Paso, in the extreme western part of Texas, is a very dry, medium altitude (3700 ft.) resort. The climate in the high altitude resorts in the northern part of New Mexico is similar to that of Colorado, and as one goes further south the average temperature rises. Prescott and Flagstaff represent the high altitude resorts

in Arizona. Salt Lake City, in Utah, has an elevation of 4300 feet, and possesses a dry, pure, stimulating air. It is, however, hot in summer and rather cool in winter.

In the great Rocky Mountain region, in the high altitudes and the dry plains, unlimited opportunity is afforded for life in the open air, restricted, however, to a few resorts on account of the absence of skilled medical supervision and proper accommodations and food. It must be admitted, however, that many a young man, with a naturally vigorous constitution and limited local disease with but slight activity has "roughed it" in this land of sunshine, taken his "chances," and recovered. Such a procedure is not, however, to be recommended save in exceptional cases.

In Europe the high altitude climatic resorts are found in the Alps, at such places as Davos, Arosa, St. Moritz, and Leysin. In many of these places are excellent sanatoria. The snow which covers the ground for so long a period of the year at this latitude conduces to the purity of the air.

There are innumerable resorts of little or medium altitude in Europe, notably in the Black Forest, the Bavarian and the Hartz Mountains, the Tyrol, Silesia, and the Taunus Mountains, and in Switzerland. The renowned sanatoria of Nordrach, Falkenstein, and Görbersdorf are situated respectively in the Black Forest, the Taunus, and the Silesian Mountains. Les Avants, in Switzerland, of an altitude of about 3000 feet, overlooking the Lake of Geneva, and Montreux, 2000 feet below it, are much frequented open-air resorts, and possess a pure, dry atmosphere. In both places abundant and excellent accommodations are afforded. Almost every European country has found favorable regions within its own borders for consumptive sanatoria, just as the various States in the United States are now doing.

The only very dry, warm winter climate near at hand to Europe is that of the Egyptian desert, which is also frequently visited by Americans. It exhibits the climatic characteristics of arid regions in low altitudes; namely, warmth, great purity of air, continuous sunshine, great diurnal variation of temperature, dryness of atmosphere, and little or no rain. It is comparable in this country to southwestern Arizona. Helouan, Luxor, and Assouan are the principal resorts and furnish good accommodations. The effect of the climate is bracing and tonic. Both early and more advanced cases of tuberculosis are considered suitable for this climate if the symptoms are not acute.

In selecting a suitable climate and resort for any particular case of tuberculosis, the first question to be decided is whether the case is a suitable one to be sent away at all, and there are a number of conditions with reference both to the disease and to the individual which render it inexpedient to advise a change. Such conditions are, first, an acute or active form of the disease; second, advanced cases with septic symptoms of secondary infection, such as fever, night-sweats, etc.; third, cases in which the local and constitutional condition would permit of a change, but who have so little persistence of purpose and self-control

that they could not be depended upon to carry out any plan of treatment if left more or less to themselves. The best place for such persons is a sanatorium, and a change of climate may be recommended for them if in the resort selected a sanatorium exists.

We have remaining, then, the following variety of cases which may be benefited by a change to a more favorable climate: (1) Early cases with slight local disease and little or no constitutional disturbance and no disease of other organs. Such cases will do well in almost any climate, but perhaps the high altitudes are to be especially recommended for them. (2) Second-stage cases in the quiescent state, with no serious constitutional disturbance and a fair amount of general strength. These also do well in the mountain climates of greater or less altitude, as also in the dry climates of the plains. The personal idiosyncrasy, condition of the appetite, digestion, ability to resist cold, will influence the choice in such cases. (3) Third-stage or advanced cases, with little general disturbance and still considerable strength remaining. Such cases should not, as a rule, be sent to the high altitudes, but rather to the dry, warm climatic resorts at or near sea-level, such as those in southern California or the Pine Belt of the South. (4) Cases of cavities, if they are not large, and where the disease is quiescent. Such may be sent also to the altitudes or the plains. (5) More or less advanced cases with softening and excavation going on, accompanied with much cough and profuse expectoration and symptoms of a mixed infection. If cases of this kind can comfortably be transported, either to a warm, moist climate, like the south coast of Florida or Nassau, for example, or to a warm, dry climate, as in some of the various resorts in the Pine Belt region or southern California, for the winter, life may be prolonged and made more comfortable.

Next we will consider cases unsuitable for the high altitudes, but which may or may not be sent elsewhere: (1) Those of advanced age. (2) Those with double cavities, with or without pyrexia. (3) Cases in which there is great irritability of the nervous system. (4) Those complicated with diseases of the kidney, liver, and some forms of cardiac disease. (5) Diabetes. (6) Those with great loss of pulmonary tissue. (7) Emphysema. (8) Tubercular laryngitis, unless local expert treatment can be obtained for them in the chosen resort.

Hemorrhage does not contraindicate altitude. With regard to heart disease and altitude there is a diversity of opinion and experience. There seems, however, to be considerable evidence to prove that uncomplicated regurgitant lesions, with a fairly well-nourished myocardium, do not contraindicate a high altitude, but, on the other hand, that pronounced aortic or mitral stenosis does.[1]

A list of interrogations is herewith given which may aid one in coming to a conclusion regarding a change of climate for the tuberculous patient: First, Is the patient's local and general condition such that a change will be beneficial? In determining this question we must carefully

[1] Babcock, High Altitude and Heart Disease, Transactions of the American Climatological Association, vol. xv, 1899, p. 159.

consider both the individual and the disease. Regarding the individual, we have to inquire into his physical and mental characteristics. For example, Does he endure cold or heat well? Is he naturally delicate or robust? Is he of a nervous or phlegmatic temperament? Does he possess much or little will power? We must note, also, the age, sex, habits, the condition of the circulation, digestion and appetite, the presence of other diseases, such as cardiac, renal, rheumatic, diabetic, diarrheal, etc.; inherited tendencies; the condition of the non-tuberculous lung, if both lungs are not affected, as well as the condition of the upper respiratory tract and other organs, is to be carefully determined. Regarding the disease, we have to consider its extent and situation; its form—whether the fibroid or caseous tendency predominates; the rapidity of the local process; the cough and expectoration; the effect of the disease upon the general system and bodily functions; whether or not hemoptysis has occurred.

If, after this inquiry, we decide that the patient's general and local condition is such that a change of climate is desirable, the next question to be decided is what kind of a climate and resort will suit his condition best, both general and local, and under this head we must bear in mind the indispensable conditions required of any and every climate and resort; namely, purity of air, the opportunity of utilizing to the utmost this pure air, and the absence of unfavorable climatic factors—unfavorable in general and unfavorable to the especial case under consideration.

Having determined upon a certain kind of climate as the most suitable one for the patient under consideration, we have next to consider the resorts which afford the climate of our choice, and in making the selection, there are various questions relative to the resort which come up for solution. First, the local topography of the resort, for the configuration of the land often modifies the climate, sometimes detracting from otherwise favorable climatic conditions. Second, the sanitary conditions and the water-supply. Third, the facilities for comfortable living, wholesome and comfortable lodging, good food. Fourth, and most important of all, the presence of a reliable physician, with experience in the treatment of tuberculosis, to whom the patient can be referred. In sending a consumptive away we should place him unreservedly in the hands of the local physician of the place to which he goes, and no attempt should be made to direct the treatment by the physician at home. Fifth, what amusements and diversions does this resort afford? Sixth, the probable expense; and, finally, the accessibility of the resort and the comfortable means of reaching it.

In many health resorts, particularly in the South, it is becoming increasingly difficult for an individual who is known to be tuberculous to obtain entrance into a hotel or boarding-house. Often the only way is to set up housekeeping one's self or enter a sanatorium if one exists in the place. Before starting for any resort the accommodations should be secured in advance, for it has happened more than once that

a poor consumptive on arriving at his destination has been refused admission to the hotel or boarding-house.

Again, the question of continuous residence is to be decided in the selection of a resort, and if it is decided wiser to retain the patient in the new climate throughout the year, then such a place is to be chosen as affords the desired climatic conditions and is open the whole year. Many places, like Phœnix, Arizona, or Aiken, South Carolina, are too hot for a comfortable summer residence, and many have only a winter season. Sometimes, of course, a change either in summer or winter is desirable and beneficial.

Another question which may have an influence upon a choice of climate and resort is the season of year in which the disease is discovered or the change is to be made. Obviously, a southern or southwestern resort is inapplicable in the summer, and with some cases a high altitude resort in the higher latitudes, like Colorado, is not to be chosen in the winter. The wisest course may be to put the patient under the most favorable conditions at home temporarily until the season arrives for the best utilization of the selected climate, or to make use of one of the available climates at the season the change is desired, and later remove to the region which is considered more appropriate for the individual case.

The many resorts of low or medium altitude in the East, as the Adirondacks, White Mountains, Asheville, North Carolina, the Berkshires in Masachusetts, many places in Vermont, Pennsylvania, northern New York, and elsewhere, and those in southern California and all the high altitudes in Colorado and New Mexico, are applicable for the majority of curable cases in the summer, while in the winter we have the Pine Belt of the South, the southwestern regions in Arizona, Texas, and parts of New Mexico and southern California, as well as many of the above-mentioned resorts, which can be utilized the entire year.

We have next to consider the matter of expense. Can the patient afford the expense of the change and the long sojourn abroad? Again, Is he one who will be benefited if he goes alone? or, if not, Who will go with him? What is the temperament and what are the tastes of the patient, and how will he be affected by the change? What effects, moreover, will separation from home and usual environment have upon him? How long can he stay away from home, and how long a journey can he take without injury? Is it desirable that he should go to such a place as his friends can readily reach? If his disease is arrested in the selected climate, will he be able to return home and resume his former life? Is the climate suitable for his relations who may accompany him—his wife or children, for example? Can the patient engage in any occupation or is he obliged to do so for his own support?

With regard to the return from Colorado or other high-altitude resorts, the opinion and experience of those who have sent many patients there, and of the local physicians who have treated them under these conditions, seem to be that it would be safer, for some at least, who

have obtained an arrest to remain permanently there,[1] and this fact must be carefully considered in recommending a high-altitude climate.

With regard to sending away febrile patients, as a rule, this should not be done. If, however, the disease is in the incipient stage, or not far advanced, and the general condition is fairly good and the fever has not lasted many days or weeks, and the progress of the case is not rapid, then it may be advisable to send the patient away with the hope that the change will be instrumental in abating the fever. If, however, the disease is more advanced and rapidly progressing, the fever has long continued, and the bodily condition is much impaired, the patient is to be made as comfortable as possible and treated at home.

SPECIFICS, ANTISEPTICS, AND GENERAL MEDICINAL TREATMENT

The activity in the search for a specific for tuberculosis is at the present time great, and it is to be hoped that this search may finally be rewarded. As yet, however, no genuine specific, either in the form of drugs, antiseptics, serums, or bacterial extracts, has been discovered which has stood the test of time. Innumerable preparations and methods of treatment have, at one time or another, been exploited as specifics after a limited and inconclusive trial, only to fall into desuetude as more extended use has proved their failure. As Penzoldt has well said, "If only a portion of the innumerable new remedies for tuberculosis accomplished what their enthusiastic promoters affirmed—that they were unfailing cures—the wonder is that any tuberculosis remains."

Tuberculin

Of all the suggested specifics, tuberculin and antitoxic serums appear to be the most promising possibilities, especially the former, tuberculin. Introduced many years ago by Koch, it at first produced disastrous results from the ignorance of its use, enormous doses being given, which practically poisoned the patients. Long experience, however, has taught us that it is not a specific in any true sense of the word, but employed in proper doses, and used in coöperation with the hygienic-dietetic treatment, it has aided the cure and made it more permanent. There exists a large amount of evidence extending over many years in favor of its therapeutic value. Brown, of Saranac,[2] from an experience in 160 cases at the Adirondack Cottage Sanatorium, states that one of the immediate results of the tuberculin treatment is that the percentage of patients who have lost their bacilli is greater than the percentage of such in the total number of cases (1500), and that the ultimate results show that the tuberculin-treated cases have fewer relapses. Moeller and Kayserling,[3] from an extensive experience at the sanatorium at Belzig, conclude that tuberculin exercises a curative effect and is decidedly valuable. Moeller[4]

[1] Transactions of the American Climatological Association, 1890, p. 189.

[2] Journal American Medical Association, November 26, 1904, p. 1603.

[3] On the Diagnosis and Therapeutic Use of Tuberculin, Zeitschrift für Tuberculose und Heilstatenwesen, vol. iii, No. iv, 192.

[4] Lehrbuch der Lungen-Tuberkulose, 1910, p. 218.

declares that in 50,000 injections of tuberculin which he has given he has never met with either a serious local or general injury from the same, and declares, on the ground of his large experience in the use of this remedy, that it is an exceedingly valuable means in the treatment of tuberculosis, and that especially good results are obtained when it is combined with the hygienic-dietetic treatment.

As regards the permanency of the cure, these authorities consider the results from the combined hygienic-dietetic and tuberculin treatment very favorable. In advanced cases (second and third stages) a continued improvement in the condition of the lungs was observed. Goetsch,[1] from an experience of ten years in the use of tuberculin, considers it of much value, and in this opinion Petruschky, Spengler, Krause, Heron, Sahli, Denys, and Löwenstein, together with other foreign and home phthisiotherapeutists, coincide. Trudeau,[2] from an extensive experience in its use, says: "My experience with tuberculin treatment at the sanatorium thus far has led me to believe that when carefully applied in suitable cases, it has proved apparently free from danger and it has seemed to have some favorable influence in bringing about healing of the lesions." Koch, who originally advised the use of tuberculin, always maintained its therapeutic value in curable cases. Thus, the usefulness of tuberculin in conjunction with a hygienic-dietetic treatment seems to be established where it is properly used in suitable cases.

The theory of the action of tuberculin most generally held is that it stimulates the body-cells by its toxins, resulting in the production of antibodies by these cells. The ultimate object sought is an active tuberculin immunization of the individual—in other words, the tuberculin injection intensifies or adds to the resistance of the body to the disease, so that it may become effective in its conflict with the toxemia. There must, however, exist in the individual who receives the tuberculin treatment more or less power of resistance, and this fact must be borne in mind in the selection of cases for tuberculin treatment.

The methods of administering tuberculin are three: first, the tolerance method, considered by Trudeau and others as the safest and best. This method consists in beginning with a very small dose of tuberculin, and after a proper interval (three or four days), a small increased dose is given, and so on, the increase being so gradual and small that no reaction is induced. Second, the reaction method, which consists in giving such a dose as will produce a mild reaction, the theory being that such a reaction produces the maximum amount of antibodies. Whether such a reaction is harmful or not is still an unsettled question. Third, Wright's opsonic index method. This method consists, in brief, in giving the tuberculin according to the opsonic index of the blood-serum, the object being to increase the tuberculo-opsonic content of the blood and not produce tuberculin immunity or reaction. This method is not in favor to-day with phthisiotherapeutists, and even Wright himself declares that it is of no value except in very early cases. He has,

[1] Deutsche medicinische Wochenschrift, January 20, 1901.
[2] Transactions of the Association of American Physicians, 1900.

however, shown that small doses of tuberculin, employed according to his method, give very excellent results in surgical tuberculosis, and others have also demonstrated its value in such cases.

As to the class of cases most likely to be benefited by tuberculin, first of all it is to be remembered that the patient must show some resistance to the infection, and in whatever stage the tuberculin is employed, the general condition of the patient must be fairly good. We have, then, as suitable for tuberculin treatment, first, early cases with small local lesion; second, moderately advanced cases which have remained stationary under the hygienic-dietetic treatment; third, cases in which the physical signs are extensive, but the general condition is good and the symptoms slight. Fever has generally been regarded as a contra-indication to tuberculin, but recent experience shows that when a slight rise in temperature persists from normal to 99.5° or 100° F., and other conditions are not unfavorable, tuberculin may produce a decided improvement and often a reduction of the temperature. Brown[1] gives the following wise advice to be given a patient inquiring about tuberculin: "He should be told," says Brown, "that tuberculin properly given will not harm him, may produce no immediate results, but may act very beneficial both in regard to the future (relapse) and on the symptoms. It should be carefully stated to him that treatment for two or three months is of little avail, and that it means six to nine months at first and later a repetition of the treatment." If the tuberculin treatment is successful and doing good, this is manifested by an improvement in the general condition and the symptoms. The appetite and digestion improve, the bodily vigor is increased, and usually the weight goes up. In not a few cases bacilli disappear from the sputum, the cough lessens or may entirely cease, and the amount of expectoration is diminished. Night-sweats, if present, are often favorably influenced.

There are very many preparations of tuberculin which have been or are still in use, but it is doubtful if any one of them has any special advantage over another, and it is, therefore, hardly necessary to enumerate all of them. There are four which to-day are most commonly employed, namely: (*a*) Koch's Old Tuberculin, O. T. (*b*) The Broth Filtrate of Denys, B. F. (*c*) Koch's Tuberculin Rest, T. R. (*d*) The New Tuberculin or Bacillen Emulsion of Koch, B. E. These four preparations are the ones almost universally selected, and their popularity is in the order given above.

It may be well to state here briefly what tuberculin is, that is, its composition. It is a filtered culture fluid upon which tubercle bacilli have been grown, and which contains certain soluble toxins given off during the growth of the bacilli, and it is to these toxins that the curative properties of tuberculin are due. The tubercle bacilli are grown upon a slightly alkaline glycerin-bouillon medium, and after they have grown from six weeks to two months, the fluid is passed through a porcelain filter to remove the bodies of the bacilli, and it is then evaporated to one-tenth of its original bulk. In appearance it is of a dark-yellowish

[1] Klebs, Tuberculosis, 1909.

color. The tuberculin filtrate of Denys is prepared without being subjected to heat and is not concentrated. In preparing the T. R. tuberculin, the dried culture of the tubercle bacilli are ground up in a mortar and are then centrifugalized in distilled water and the fluid poured off. This is again centrifugalized, and the remaining fluid is the T. R. The Bacillen Emulsion is different and consists in an emulsion of the pulverized bodies of the bacilli preserved in glycerin.

In the following directions for the use of tuberculin the tolerance method will be the one employed, which consists in using small doses and gradually and slowly increasing the same, avoiding reaction. By this method ambulant patients can be treated and even can pursue their occupations while under treatment; thus any general practitioner can employ tuberculin, if used with care, by having his patient come to his office for the injections. In this method of treatment the ultimate object is to carry the patient up to the measure of his individual tolerance and to avoid reaction. As, however, we have no means of knowing what is the exact increase of the dose for any individual, reaction will sometimes occur, and it is, therefore, well to know in what it consists. First, we have the local reaction at the site of the injection, which is considered by Hamman[1] as the most sensitive and most constant sign of approaching tolerance. It consists of a redness, swelling, tenderness, and pain at the site of the injection, coming on from six to twelve hours after the injection, and lasting from two to four days or longer. Second, general constitutional symptoms, usually considered as *the reaction*. The most important of these symptoms is fever, and hence the necessity of knowing the patient's temperature, which should be taken four times a day—at eight, four, twelve, and eight. Even a slight rise of temperature is significant and should be considered a sign of reaction. In addition, we may have a feeling of general malaise, such as headache, insomnia, anorexia or digestive disturbances, pains in the limbs, chest, or stomach, restlessness, nervousness, and loss of weight. Third, the reaction, as indicated by the physical signs, which are only evident after a severe general reaction, and consist of an increased cough and expectoration, dyspnea, and perhaps increase in the râles. The most important factor in estimating a reaction, according to Hammer, is the temperature curve.[2]

The beginning dose, as has before been said, is a very small one, in order that we may avoid a reaction and be well within the limits of safety.

Of the O. T. tuberculin, $\frac{1}{10,000}$ to $\frac{5}{10,000}$ mg. is used, or if there is fever, $\frac{1}{100,000}$ to $\frac{2}{100,000}$ mg. These doses are much smaller than were formerly used by Koch and others, which were from $\frac{1}{1000}$ to $\frac{1}{10}$ mg. At intervals of from twice to once a week the injections are repeated with a gradual increase, until finally $\frac{1}{10}$ mg. is reached, and then the injection is given only once a week. The dose is then still further increased until tuberculin immunity is finally attained, which must necessarily vary with

[1] Louis Hamman, The Use of Tuberculin in Treatment, International Clinics, vol. iv, nineteenth series, reprint.

[2] Proceedings of the Sixth International Congress on Tuberculosis, vol. i, part 2, 1908.

each individual and may be as high as 1000 milligrams or 1 gram or more. In each case, be it repeated, the maximum dose is to depend upon the tolerance of the patient, as also the rate of increase. In the beginning the dose, being so small, can often be doubled each time, unless, of course, any evidence of reaction is observed, and in such a case one must go slower. After $\frac{1}{100}$ mg. is reached, it is advisable to go more slowly, thus, $\frac{2}{100}$, $\frac{3}{100}$, $\frac{4}{100}$ mg., etc. The scale of increase is as follows: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, etc. If a reaction occurs, it is found to happen most commonly when the increase is the largest, and in such an occurrence no further injection should be given for ten days until all symptoms have disappeared, and then we must begin with much smaller doses.

The beginning dose of the B. F. or Bouillon Filtrate of Denys is the same as with the O. T., $\frac{1}{10,000}$ mg. Of the T. R., the beginning dose is the same as that of the two other preparations, $\frac{1}{10,000}$ mg., and the final dose may reach as high as 20 mg. or more. Of the Bacillen Emulsion (B. E.), the initial dose is $\frac{1}{100,000}$ mg., and the final dose is 5 mg., more or less, according to the individual tolerance. When $\frac{1}{100}$ mg. is reached, the interval should be a week. The largest dose should be given only at intervals of two or four weeks. As has been indicated, the guide to the increase of the dose is the reaction or, rather, the avoidance of reaction. It is, therefore, safer and wiser to be slow and cautious in the increase of the dose, and extend the treatment over many months. It is always well to remember that the increase in dose and the maximum amount is more or less arbitrary, depending upon the susceptibility of the patient. As Trudeau well says, "The main features in our treatment must be to raise the degree of tolerance of tuberculin to the highest point attainable in each case, by an almost imperceptible and long-continued progression in dosage, to avoid general and local reaction as much as possible, and consider them merely as evidences of tolerance, to follow no arbitrary rule as to the rate of increase or the maximum dose to be reached, but to be guided by the degree of tolerance of each patient, as shown by the symptoms and general condition, whether the highest individual maximum dose attainable be only a small fraction of a milligram or a cubic centimeter or more."[1]

The various tuberculin preparations are readily obtained from reliable sources, and even the dilutions can be obtained ready for use if desired. It is not difficult, however, for the physician to make his own dilutions, and only care and exactness are required. The apparatus needed are a number of small wide-mouthed glass-stopper bottles and three glass pipets, one holding $\frac{1}{10}$ c.c., graduated into hundredths of a cubic centimeter; the second holding 1 c.c., graduated into tenths of a cubic centimeter, and the third holding 10 c.c., graduated into tenths of a cubic centimeter. These should be boiled before use or kept in a solution of 2 per cent. carbolic acid or alcohol and thoroughly rinsed in the diluting liquid before using.

[1] Proceedings of the Sixth International Congress on Tuberculosis, 1908, vol. i, part 2, p. 800.

The diluting solution generally used consists of one-fourth of 1 per cent. carbolic acid in physiologic salt solution (0.8), which should be filtered and boiled. There should be no sediment in the solution. To make the solution, one-tenth of the original tuberculin is removed by the first pipet, and to it is added 9.9 c.c. of the diluting fluid, which gives a 100-fold dilution, of which $\frac{1}{10}$ c.c. equals 1 mg. of tuberculin. From this number 1 dilution, $\frac{1}{10}$ c.c. is removed and 9.9 c.c. of the diluting fluid added, which gives a 1000-fold dilution, or $\frac{1}{1000}$ mg. in $\frac{1}{10}$ c.c. of the dilution. Next, from this number 2 dilution $\frac{1}{10}$ c.c. is taken, to which 9.9 c.c. of the diluting fluid is added, which gives a 10,000-fold dilution, or $\frac{1}{10,000}$ mg. of tuberculin in $\frac{1}{10}$ c.c. The dilutions can be thus continued until in $\frac{1}{10}$ c.c. the proper dose is obtained. Hamman and Wolman at the Phipps dispensary of the Johns Hopkins University make their dilutions so that each bottle is one-tenth as strong as the preceding number, starting with the number 1, the pure tuberculin. Thus, bottle No. 2 contains 100 mg. of tuberculin to each cubic centimeter. Bottle No. 3, 10 mg.; bottle No. 4, 1 mg.; bottle No. 5, $\frac{1}{10}$ mg.; bottle No. 6, $\frac{1}{100}$ mg.; bottle No. 7, $\frac{1}{1000}$ mg. per cubic centimeter, etc. The various solutions must be kept in a refrigerator and fresh ones prepared every two weeks.

The injections are made subcutaneously in the back below or near the angle of the scapula or in the intrascapular region, one and a half to three inches from the spine. A glass syringe is used, of the capacity of $\frac{1}{2}$ or 1 c.c., graduated into hundredths of a cubic centimeter, and a very fine needle. Both needle and syringe should be boiled before using. The site of the injection should be thoroughly cleansed with absorbent cotton and 95 per cent. alcohol. The two forms of syringes recommended are those made by the Randall-Faichney and the Wellcome-Burroughs Companies. The amount of the fluid injected may be $\frac{1}{10}$ or 1 c.c., according to how the solution is made.

Latham,[1] in conjunction with Inman, has shown that tuberculin can be given with effect by the mouth. Employed in this way it is administered on an empty stomach, the dose, so far as these investigators can judge, being equal to about one-half the same dose given subcutaneously. As a general rule, they declare, one can commence with a dose (in adults) of $\frac{1}{50,000}$ to $\frac{1}{20,000}$ mg. by the mouth in acute cases, and with a dose of $\frac{1}{10,000}$ in chronic cases. These investigators, however, state that the administration of tuberculin meets with little if any success so long as successive auto-inoculations (caused by exercise of any kind, bodily movements, cough, deep breathing, etc.) spontaneously occur and cannot be eliminated by the means at one's command. Absolute rest is the most efficient means of eliminating auto-inoculation.

The annexed "Tuberculin Record," published by the "Journal of the Outdoor Life," affords a satisfactory method for the tuberculin patient to carefully note his symptoms, and also enables the physician to properly graduate the dosage (Fig. 101).

[1] A Contribution to the Study of the Administration of Tuberculin in Pulmonary Tuberculosis, Lancet, October 31, 1908, reprint.

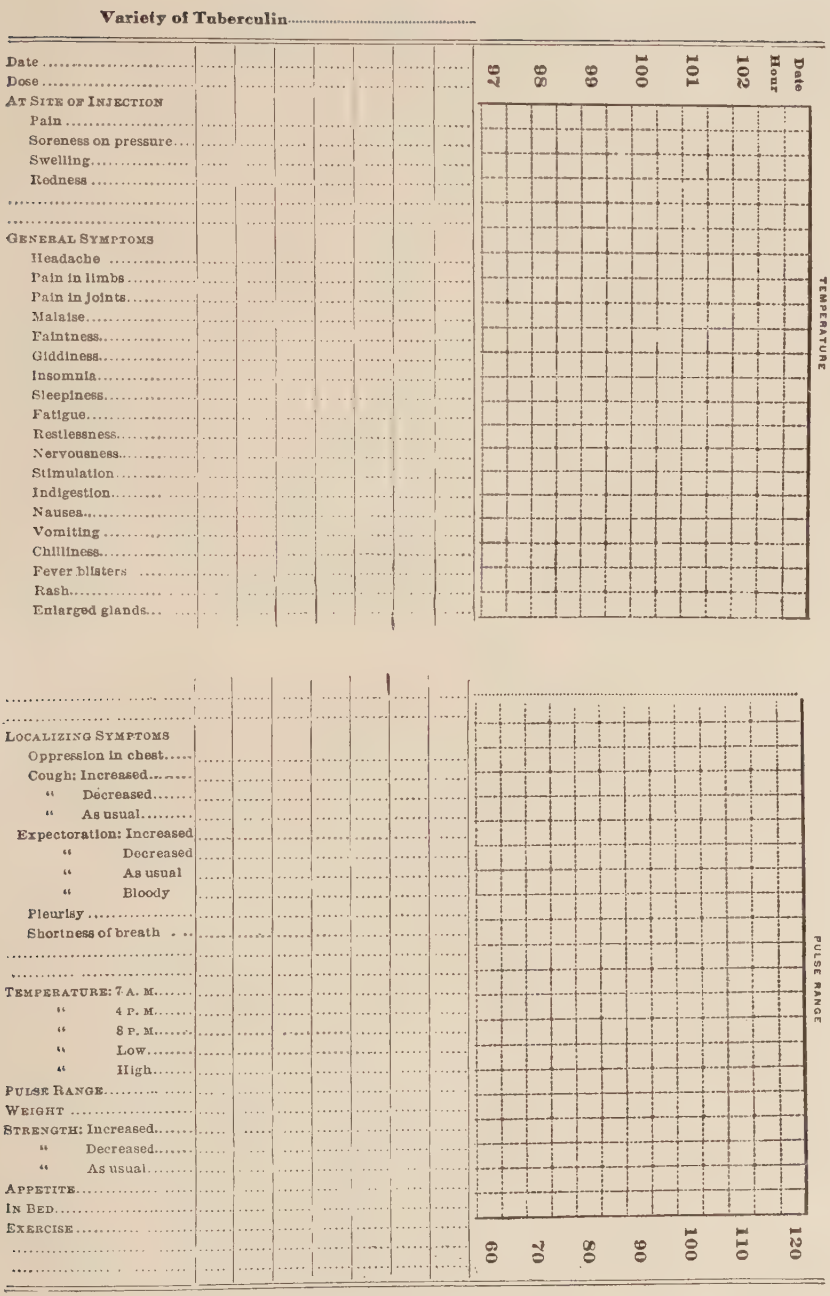

Fig. 101.—Tuberculin record.

Antituberculous Serums

To produce an effective antitoxin for the various infectious diseases, like the diphtheria antitoxin, is the goal toward which numberless investigators in all parts of the world are striving, and tuberculosis, from its importance, has received a large share of attention in this direction. Maragliano, of Genoa, and Marmorek, of France, have produced serums which have been accorded the most extensive therapeutic trial. The serum is obtained from immunized horses, asses, dogs, or goats in a manner similar to the production of the diphtheria antitoxin. Maragliano believes that he can induce in a tuberculous individual by means of his serum a condition which he designates as a "passive immunization." Marmorek and his enthusiastic disciples likewise affirm that the Marmorek serum will neutralize the tuberculous toxins and cause the various symptoms of the disease—fever, sweating, loss of appetite, etc.—to disappear. The serum is most effective in early cases when the tuberculous infection appears to be a pure one. Other investigators, from their clinical experience with the serums, have not met with such favorable results. Flick, in a paper read at the Sixth International Congress on Tuberculosis[1] upon the Maragliano serum treatment at the Henry Phipps Institute in Philadelphia, concludes that the consensus of opinion of the staff seems to be that the serum had no special value, and Wolman, of the Johns Hopkins University, in a report of 19 cases treated at the Phipps Dispensary with Marmorek's[2] serum, reports that none of the early cases showed any beneficial effects, and of the advanced cases, only 2 showed an improvement in symptoms which might be ascribed to the serum. "A critical estimate," says Baldwin, "of the clinical results of antituberculous serum treatment produces the impression that the favorable result may be accounted for by the non-specific stimulus given to the tissues which may aid nutrition."

It is too early, and the clinical data at hand are not sufficiently extensive, to enable one to arrive at any definite conclusion regarding the real therapeutic value of the serum treatment; the principle is certainly based on a solid foundation, and we may hope with some confidence that eventually either an antitoxin or serum will be evolved which will, in fact, exercise a controlling influence over the disease.

The serum-of Maragliano is prepared by Merck, of Darmstadt, and is used subcutaneously in doses of 1 c.c. for patients with little or no fever every other day for the first week, and daily for the second week; for the third week, 2 c.c. are given daily. If there is considerable fever, Maragliano begins with a dose of 10 c.c., and if the fever subsides, he gives daily ½ c.c., and after eight days again 10 c.c. The treatment lasts several months.

Marmorek makes the injections of his serum in series with intervals of rest, the dose depending upon the condition of the patient and the

[1] Transactions, vol. i, part 2, p. 807.

[2] P. T. Wolman, Marmorek's Serum in the Treatment of Pulmonary Tuberculosis, Johns Hopkins Hospital Bulletin, August, 1909, vol. xx, No. 221.

disease and his tolerance of the serum—in light cases small doses, and in more severe and acute cases larger ones.

Richer, of Montreal, gives 10 c.c. during the first three days, 2, 4, and 4 c.c. respectively, then an interval of ten or fifteen days, when a repetition of the three doses is made and another interval of rest follows. and the plan is pursued until 50 c.c. have been given, then 5 c.c. are given once a month for four or five months.

Drugs

Many attempts have been made, by means of various antiseptic agents, to produce some inhibitive or destructive influence upon the tubercle bacilli at the seat of the lesion. Such agents have been given by the mouth, injected subcutaneously or intravenously, or directly into the lungs, or used in the form of inhalations, sprays, or by intralaryngeal injections. Such attempts to control the local infection have all failed, and most of them have been abandoned.

Creosote may be considered as such an agent, and is still extensively employed, not only for its supposed local influence, but as well for its general beneficial effect. It is difficult to determine how much and what good creosote does in tuberculosis—there are so many conflicting opinions and different results reported by different observers. It is a significant fact that in many of the most skilfully conducted sanatoria which have obtained most satisfactory results creosote has been but little if at all used. Cornet [1] says that the essential factor in the benefits derived from its use is probably the improvement of the digestion, of the appetite, and of the nutrition, which is at times seen to follow its use. A. L. Loomis and Bridge believe that it is principally useful in arresting intestinal fermentation. Powell, Latham, Ransome, and others consider that it not only produces a beneficial effect upon the digestive organs, and so upon the general nutrition, but also is of undoubted value in lessening the cough and the amount of expectoration.

Flick [2] says that the one remedy which brings some comfort and encouragement in the struggle against the condition of mixed infection is creosote, which in large, well-sustained doses will greatly reduce the suffering from consumption and will conduce to recovery. The writer may perhaps be pardoned for expressing his own conclusions, based upon many years of experience in the use of the drug, that other than a beneficial effect, in many cases, upon the digestion and nutrition, it exercises no appreciable influence upon the course of the disease. In spite of the dubious value of creosote, it is still perhaps more widely employed in tuberculosis than any other one drug, and, if the truth were told, we use it many times because, desiring some kind of medication, creosote occurs to us at once as a remedy sanctioned by almost universal use.

It is well to bear in mind in using creosote that there are cases in which it is distinctly injurious, producing anorexia, vomiting, indigestion,

[1] Tuberculosis, Nothnagel's Encyclopedia of Practical Medicine, p. 582, 1904.
[2] The Therapeutics of Tuberculosis, reprint, p. 15, 1900.

and diarrhea. There are also certain contraindications to its use—nephritis, hemoptysis, any disturbance of the appetite or digestion, and, according to Hare, fever.

Either the pure beechwood creosote is used or some of its many derivatives or compounds, and one begins with ½ or 1 minim of the pure creosote, and gradually increases it until 10 minims are reached, when this dose is continued indefinitely according to the indications. Very much larger doses have been given and recommended, but the writer believes that whatever beneficial effects are produced from the drug can be obtained from a moderate dose, and there is less likelihood of disturbing the digestion. It should be administered after meals and not upon an empty stomach. It may be given alone in large draughts of hot water, as Flick advises, or in milk, wine, whisky, or some of the malt preparations, in combination with cod-liver oil or its emulsions, or in tablets or capsules; the following is a popular formula:

℞. Creosote (beechwood).....ʒj (4.0)
Tincturæ gentianæ compositæ.....ʒj (30.0)
Spiritus vini rectificati.....ad ʒviij (224.0).—M.
Sig.—A teaspoonful after meals (about 1 minim of creosote) in a wineglassful of water or wine t. i. d.

Or this (Yeo):

℞. Creosote (beechwood).....♏ xxiv (1.56)
Glycerin.....ʒij (60.0)
Tincture orange peel.....ad ʒiij (90.0).—M.
Sig.—Teaspoonful after meals in a wineglassful of milk and water, weak brandy and water, sherry, or Malaga wine.

Creosote is also administered by inhalation for its general effect, and this method is highly extolled by Robinson, of New York, who has used it for many years, with much benefit, he believes. A perforated zinc inhaler (Yeo's) is employed for this purpose, and the creosote is dropped upon a sponge or absorbent cotton placed within it. In order to obtain much effect, however, the inhalations must be frequently repeated and for a considerable length of time at each inhalation. Creosote used in this way is apparently most efficacious where there is profuse secretion and constant harassing cough, or where there is a chronic bronchitic condition.

The carbonate of creosote, which contains about 90 per cent. of creosote, called "creosotal," or the carbonate of its principal derivative, guaiacol, "duotal," which contains 90 per cent. of pure guaiacol, are considered to be less irritating to the stomach than the pure creosote. The dose of "creosotal" is the same as that of creosote, and it may be given in olive oil in capsules, in milk, wine, brandy, or whisky, with a simple elixir or any of the aromatics, or taken pure, followed by a little broth, wine, tea, coffee, or some article of food with a pronounced taste.

"Duotal" is a white, crystalline, tasteless powder, and can be administered in a dry powder on the tongue or in capsules or wafers.

One can begin with a dose of from 3 to 7½ gr., three times daily, increasing slowly until 15 to 20 gr. is reached. With children, one can begin with 1 or 2 gr., increasing to 7½ gr.

"Geosot," the valerianate of guaiacol, and "eosote," the valerianate of creosote, are other creosote preparations well spoken of, and are given in capsules containing 3½ gr. each, one or more after meals.

Still other creosote preparations, and they are almost innumerable, are: Phosphite of creosote, "phosphotal," recommended by Bernheim, who considers it the best of the creosote preparations, the dose of which is 7 or 8 gr. (0.460 or 0.520 gm.); "thiocol," 15 to 22 gr. (0.972–1.425 gm.) two or three times a day before meals, which is said to aid the appetite and prevent fermentation; "sirolin," a syrup of thiocol, given in doses of a tablespoonful t. i. d. for adults, and a teaspoonful for children, for whom it is said to be especially useful; "histosan," an albuminate of guaiacol, given in doses of 3 or 4 tablespoonfuls a day for adults and 3 or 4 teaspoonfuls for children; benzosol, tanosol, iodocol, and pulmoform, a combination of formaldehyd and guaiacol, are other preparations.

The Mercury Treatment.—Recently, Dr. Barton Lisle Wright, of the U. S. Navy, has brought forward the use of mercury by means of deep muscular injections in the treatment of tuberculosis, and from a considerable experience in its use at the U. S. Naval Sanatorium in Las Animas, Colorado, reports favorably as to results, and others in England and this country also report success in its use. Dr. Wright thinks the mercury acts in two ways: first, as a tonic, increasing the vitality of the cellular elements of the various organs and tissues; and, second, that it renders the blood bactericidal, producing an antitoxin therein, which has a direct destructive action upon the tubercle bacillus. The form of mercury which Dr. Wright employs is mercuric succinimide. Beginning with $\frac{1}{15}$ gr. and injecting it deep into the muscles every day, slowly increasing the dose until a slight tenderness of the gums or a slight diarrhea is produced, when the dose is reduced until these symptoms are overcome. After thirty injections have been given, there follows a two-weeks' interval of rest, when the injections are resumed, beginning with the dose given at the last previous injection, and continuing with this dose as long as the patient continues to improve, until thirty injections have been given. If any untoward symptoms arise or the patient does not appear to be doing well, the dose is reduced, or alternate injections of mercury with injections of arsenious trioxid $\frac{1}{30}$ gr., and ferrous citrate, ½ gr., as recommended by Harris, of Providence, R. I., are employed for a short time. Each series of injections is to consist of thirty, with two weeks of rest intervening. As treatment progresses smaller doses of mercury are required. At the end of one year's treatment a rest of from two to three months should be given, when, if the patient is not cured, treatment should be resumed. "The above treatment, when properly carried out, first produces a fall in temperature, cessation of night-sweats, increase in appetite, slowing of the pulse, gain in weight, a better feeling, and a rapid decrease in the physical signs, also a decrease in the cough

and a more or less rapid decrease in the tubercle bacilli." It is to be remembered, however, that most of the cases treated by this method were at the same time under the favorable influences of sanatorium treatment and the climate of Colorado, although Dr. Wright compares those who took the mercury treatment with those who took only the routine sanatorium treatment, to the marked advantage of the former class. Thus, of 83 patients who took mercury, 89.16 per cent. improved, while of 78 on routine treatment, 12.82 per cent. improved.

Cinnamic acid and its derivatives, cinnamate of soda ("hetol") or potash, introduced by Landerer, has been extensively used in the treatment of tuberculosis. Its method of employment is by injections into the muscles or veins under careful aseptic conditions. Either a 1 per cent. sterile water solution of the drug or a 7 per cent. normal salt solution is used, and one begins with a dose of 1 mg. ($\frac{1}{60}$ gr. of the solid substance), which is gradually increased every two or three days by $\frac{1}{2}$ to 2 mg., until the maximum dose of 15 to 20 mg. for men and 10 to 15 mg. for women and girls is reached. This dose is continued for a month and then gradually decreased to 1 mg., and then rapidly increased again. Landerer considers three months' treatment sufficient in early cases. After four to six months one intermits the treatment for one or two months. Too large a dose is indicated by a rise of temperature, a loss of weight, and general discomfort. If the heart is weak, or if there is a tendency to hemoptysis or high fever and rapid progress of the disease, the drug should be used with great circumspection. The effect supposed to be produced by the drug is a local and general leukocytosis, a reaction in the neighborhood of the tuberculous focus, and hence a blood-count should always be made before repeating an injection to determine if the leukocytosis caused by the drug has declined, which requires from twenty-four to forty-eight hours. If good results follow the use of the drug, they are manifest in a general improvement of the symptoms—diminution of the cough and expectoration, disappearance of night-sweats, increase in weight, and evidence of improvement in the local lesion, as decrease in the bacilli, fever, râles, and diminished dulness. Landerer, the originator of this treatment, reports brilliant results, and others express favorable opinions of its value. The majority of those who have tried it, however, do not report any remarkable results. It is probable that it exercises no specific action, and whatever good it does is through its general tonic effect.

Cacodylic acid and its derivative, *sodium cacodylat*, a preparation of arsenic introduced by Gautier, is claimed by him to be less irritating to the kidneys and stomach and less poisonous than the ordinary forms of the drug, and hence can be given in larger doses, enabling one to obtain more pronounced effects. The sodium cacodylate is the preparation generally used, and is administered by the mouth in pills of 1 or 2 gr. (0.065 or 0.130 gm.), or subcutaneously or intravenously. Gautier gives as an average dose subcutaneously $\frac{1}{3}$ to $\frac{5}{6}$ gr. (0.02–0.05 gm.) daily. After eight or ten days an intermission is made for the same number of days, and then the treatment is begun again.

Gautier's formula for the solution of sodium cacodylate for subcutaneous use is as follows:

℞. Sodii cacodylatis.....gr. c (6.25 gm.)
Aquæ destillatæ.....℥iij (96.0 c.c.)
Acidi carbolici.....♏j (0.06 c.c.).—M.

Sig.—Boil and filter through a sterile filter and add ℥iij (96.0 c.c.) of distilled sterile water.

Of the above solution, the subcutaneous dose is 15 to 20 minims (1–1.3 c.c.).

What can be said as to the value of this drug can be said of arsenic in general in the treatment of tuberculosis. Buchner, the father of the arsenic treatment, believed that he obtained an increased resistance of the lung tissue, rendering it antagonistic or immune to the tubercle bacilli, thus constituting it, in fact, a specific. Most phthisiotherapeutists, however, only regard arsenic as a stimulant to the nutrition. Jacobi[1] says that he has used arsenic in tuberculosis for many years, with the effect, he believes, of increasing the amount of connective tissue. Ransome considers that arsenic owes every good influence it possesses to its action upon nutrition, and he has seen no specific result from its use.

"*Atoxyl*" is another new arsenic preparation which contains about 37.69 per cent. of arsenic, and, being forty times less poisonous, can be given in much larger doses. It is administered in doses of from $\frac{5}{6}$ to $3\frac{1}{3}$ gr. (0.05–0.2 gm.) a day, or subcutaneously in a 20 per cent. solution twice a week. Atoxyl has also been used in combination with the "hetol" treatment. Another arsenic preparation is the disodic methylarsenate, called "arrhenal"; it is given by the mouth in doses of $\frac{1}{3}$ to $\frac{1}{2}$ gr. (0.02–0.03 gm.) a day. In the early stages of tuberculosis it is said to increase the appetite, strength, and weight, and reduce fever and sweating. The specimen should be used chemically pure and free from any arsenical mineral contamination.

Formaldehyd has been used of late on the ground of its pronounced antiseptic influence upon the tubercle bacilli; it is exhibited either by inhalation or intravenous injections. By the former method two preparations are employed, "formazol" and "igazol." The patient is placed in a closed room, and for one or two hours inhales the vapor of the drug. In the latter method, introduced by Maguire,[2] a solution of 1 part of formaldehyd to 2000 parts of normal salt solution is injected into the vein to the extent of 50 c.c. daily. There is no sufficient evidence to show that any material influence is exerted upon the disease other than, perhaps, an amelioration of some of the symptoms; in some instances a diminution of the tubercle bacilli has been noted, and other observers record a favorable influence upon the secondary infection. It is to be remembered that too large doses of this drug may cause albuminuria, hematuria, and thrombosis of the veins.

Camphorated Oil.—Alexander[3] has introduced and advocated the in-

[1] Transactions of the American Climatological Association, p. 69, 1891.
[2] British Medical Journal, December 15, 1900.
[3] Münchener medicinische Wochenschrift, No. 9, 1900.

jection of sterilized *camphorated oil* in the treatment of tuberculosis, and from eleven years' experience in its use claims two favorable results. First, a strengthening of the heart when the pulse is feeble and the blood-pressure low; and, second, the production of a leukocytosis and an aseptic inflammatory border about the lung lesion, thus favorably influencing the healing process. A favorable influence upon various symptoms—fever, sweating, expectoration, sleep—has also been claimed for it. Other observers have found in the camphorated oil treatment only a heart stimulant; when the heart becomes weak and seems incapable of continuing the struggle in an advancing tuberculosis, camphorated oil appears to be of value in tiding over a crisis. Alexander uses two methods of injection, either a daily injection of 5 minims (0.3 c.c.) of a 10 per cent. solution of camphorated oil, or 15 minims (1 c.c.) for four successive days, and then an intermission of eight days, and again the injections for four days, and so on. The injections are given in the morning, a half-hour after breakfast. If given too long continuously, Alexander asserts that mild camphor-poisoning may result.

Urea.—A. L. Loomis[1] called attention to the fact that individuals of an arthritic diathesis possessed a relative immunity to tuberculosis. Working upon this hypothesis, Harper, of England, suggested that nitrogen and its products was a logical remedy for tuberculosis, in that it was supposed to increase the tendency to fibroid tissue formation. For this purpose, Harper and his followers used pure urea, beginning with 10 or 15 gr. (0.65 or 0.972 gm.) and gradually increasing to 40 or 60 gr. (2.6 or 3.9 gm.) a day. Other observers have failed to obtain any specific effect from this use of urea, such as Harper had hoped for.

Ichthyol and its Preparations.—This drug has been extensively employed in tuberculosis on the claim that it exercised an antibacterial action and increased the resisting power to the infection. Cohn, who introduced the use of this drug, says that he was astonished at the extraordinary favorable results he obtained from it. Other observers have attested its value to a certain extent, believing that it increased the appetite, diminished the cough and expectoration, and improved the general condition. Cornet says it has no specific action, but occasionally increases strength. It is administered in doses of from 2 to 50 drops of a solution of equal parts of ichthyol and distilled water, three times a day before meals in a liberal quantity of water, followed by lime-juice, lemonade, or coffee. The dose is gradually increased from 2 drops upward. It can also be given according to the following formula:

℞. Ichthyol.....gr. clx (10 gm.)
Aquæ menthæ piperitæ.....℥iiss (80 c.c.)
Syrupi simplicis.....℥v (20 gm.).—M.
Sig.—Teaspoonful in a glass of water to be taken one-half at a time.

It may also be given in capsules.

Ichthoform, from the union of formaldehyd and ichthyol, is considered by Renzi, who introduced it, to have a favorable influence upon

[1] Transactions of the American Climatological Association, vol. viii, p. 162, 1891.

intestinal complications in tuberculosis, as enteritis, diarrhea, fermentation, etc. It is given in powder in doses of from 15 to 45 gr. (1–3 gm.).

The great objection to ichthyol is its odor and taste.

Iodin and the Iodids.—This drug has been long used in the treatment of tuberculosis, but with no evidence of any specific action. Flick,[1] from his own experience, declares it a valuable remedy, and uses it in the form of europhen, in an oily mixture, applied by inunction and continued for a long time. His formula is:

℞. Europhen.....ʒj (4 c.c.)
Oil of rose.....mj (0.06 c.c.)
Oil of anise.....ʒj (4 c.c.)
Olive oil.....ʒiiss (80 c.c.).—M.

Iodopin.—Used in two concentrations of 10 and 25 per cent. of iodin respectively. Of the 10 per cent. solution one gives 1 to 2 teaspoonfuls two or three times a day, with several drops of the oil of peppermint; it can also be used subcutaneously, 30 to 90 minims (2–6 c.c.) of the 25 per cent. solution. In cases complicated with asthma or syphilis this, as well as the other preparations of iodin, is of value.

Iodocol, a combination of iodin and guaiacol, dose, 3 to 6 gr. (0.2–0.4 gm.) four or five times a day.

Iodoform, which Ransome considered "one of the best medicines for the purpose of assisting nutrition and alleviating the cough." It can be given in pill form with the extract of gentian, $1\frac{1}{2}$ to 2 gr. three times a day, or according to the following formula of Ransome's:

℞. Iodoform.....gr. iss–ij (0.09–0.12 gm.)
Codeinæ.....gr. $\frac{1}{3}$–$\frac{2}{3}$ (0.02–0.04 gm.)
Extracti cascaræ.....gr. ss–j (0.03–0.06 gm.).—M.
Ft. pil. No. i.
Sig.—One three or four times a day after meals.

Benzoic Acid and Benzoate of Soda.—Latham[2] reports good results from this drug in benefiting the general nutrition and alleviating irritative forms of cough. He gives the following prescriptions for its use:

℞. Sodii benzoati.....gr. xv (1 gm.)
Syrupi aurantii.....ʒj (4 c.c.)
Aquæ.....ad ʒj (30 c.c.).—M.
Sig.—To be taken two or three times a day, two hours after eating.

℞. Tinct. benzoin. comp.....ʒss (15 c.c.)
Pulveris acaciæ.....ʒss (15 c.c.)
Aquæ cinnamomi.....ʒj (30 c.c.)
Aquæ.....ad ʒvj (180 c.c.).—M.
Sig.—A fourth part two or three times a day two hours after eating.

Benzosol, dose, 3 to 12 gr. (0.2–0.8 gm.), in a pill or powder.

The *alkaline hypophosphites* have held a large place in the therapy of tuberculosis, being considered useful not only for their general tonic

[1] The Treatment of Tuberculosis, Medical News, September 2, 1899.
[2] Diagnosis and Modern Treatment of Pulmonary Tuberculosis, 1903.

effect, but for a supposed tendency to promote fibroid tissue formation. They are used in various combinations, especially with strychnin, which Flick considers one of the most useful remedies in this disease. There is no evidence that the hypophosphites do more than stimulate nutrition.

Eucalyptol, menthol, thymol, myrtol, tannic acid, and palladium chlorid are other drugs which have received more or less attention. Solomon Solis-Cohen reports marked improvement by the use of the latter (palladium chlorid); it is dispensed as liq. palladii chloridi in a solution of about 3 per cent. (gr. xv to ℥j), and the dose of this solution is 5 drops for an adult.

"*Zomotherapy.*"—This is the name given to a method of treatment by the exclusive administration of raw meat and raw-meat juice, introduced by Hericourt and Richet,[1] and also practised for many years and recommended by Philip, of Edinburgh. The theory upon which this treatment is based is that muscular tissue or plasma produces a kind of immunity, inhibiting the growth of the tubercle bacilli, and, furthermore, by the increased amount of nitrogen intake and retention, the tendency to the formation of fibroid tissue is increased. The two French investigators who devised the system found that when large amounts of raw meat were fed to tuberculous dogs, the disease was absolutely arrested, and even dogs in the last stages of the disease were cured. Brown,[2] the resident physician at the Adirondack Cottage Sanatorium, repeated these experiments with 5 dogs, and found that raw meat had no influence upon the duration of experimental tuberculosis; indeed, he found, on the contrary, that tuberculous dogs fed on mixed diets with no raw meat lived a much longer time than those fed on raw meat. Brown's conclusions are that meat is highly essential in the dietetic treatment of tuberculosis, and rare meat is better than that well cooked; that meat juice is of great value in suralimentation, and can be taken when the patients can take no other food; that the juice from raw meat seems slightly, if at all, more beneficial than the juice from meat slightly browned; that the disadvantages of preparing and pressing raw meat juice more than offset its advantages; meat-juice is of value, as it can be administered in the form of jellies, ices, etc. Philip,[3] on the contrary, after a trial of fifteen years of this method, believes strongly in its value, and Gailbraith,[4] in analyzing Philip's results and experience, says that it is most serviceable in the early cases, although it benefits the advanced cases; that a gradual increase of weight is observed, accompanied by firmness of tissue; that the pulse-rate is reduced and the pressure increased; the temperature also tends to improve. The blood presents a rapid increase in hemoglobin. The functions of the stomach and bowels are rendered easier and more effective. The local lesion shows conspicuous improvement. The tubercle bacilli gradually lessen in the expectoration and other discharges, and signs of

[1] Acad. des Science, Paris, February, 1900.
[2] American Journal of Medical Sciences, 1903, vol. cxxv, p. 1071.
[3] Zomotherapy, Practitioner, January, 1905.
[4] Effect of Raw Meat on the Nitrogen Metabolism in Pulmonary Tuberculosis, Practitioner, February, 1905.

quiescence and cicatrization replace signs of activity. It has been found by Hericourt and Richet that the muscle juice freshly expressed from the meat is as efficacious as the meat itself. The form and dosage, says Philip, are to be regulated in the way in which we regulate the exhibition of any drug. His mode of preparation and administration is as follows: Finely minced or bruised beef, slightly seasoned with salt, etc., is served natural, cold, or gently warmed throughout, ½ pound twice or thrice daily. The beef must be perfectly fresh.

Beef-juice.—Extract ½ pound of meat in ½ pint of cold water and ½ teaspoonful of salt for one and a half to two hours at 100° F. Express the liquid through a cloth and serve, or express the juice immediately from the meat; the juice must be freshly prepared before use.

Raw Meat Soup.—One-half pound of finely minced fresh meat is mixed in a bowl with sufficient milk to produce a thick, uniform paste; immediately before serving add ½ pint of milk at 150° F. In place of milk the soup may be made in similar fashion with stock of beef, chicken, or veal. Philip includes in his raw meat dietary raw eggs, one, two, or three of which are to be taken before meals and swallowed like oysters. If one cannot admit all that Philip and the French observers claim for this method, it at least seems evident that raw or rare meat and meat-juice are valuable adjuncts in the dietetic treatment of tuberculosis.

After the above review of the various specific and medicinal forms of treatment of tuberculosis, the immense superiority of the hygienic-dietetic method over them all stands out in bold relief; its value is attested by the experience of all phthisiotherapeutists, and the favorable results obtained by it render the present attitude toward the disease one of hope in place of the former pessimism; we can now say with assurance that "Tuberculosis is curable."

TREATMENT OF SPECIAL SYMPTOMS

Debility and Anemia.—One of the prominent symptoms of tuberculosis is debility. Not infrequently it is the earliest symptom noticed, and associated with it is more or less anemia, with frequently a progressive falling off in weight. For this condition tonics may be indicated if the hygienic-dietetic treatment, which is the most efficacious tonic, for exceptional reasons, temporarily fails, or the exigencies of the patient's condition are such that it cannot be applied in its entirety. The tonics indicated are much the same as those employed in other cases of debility, such as iron, arsenic, quinin, strychnin, the hypophosphites, lactophosphates, glycerophosphates, cod-liver oil, which may also be regarded as a tonic as well as a food; the various bitter tonics which have already been referred to, and the various malt preparations. If iron is indicated, the phosphate, peptonate, albuminate, citrate, or iodid are eligible preparations, or arsenic may in certain cases be advantageously combined with iron in the form of arseniate or cacodylate of iron. "Fersan," derived from the red corpuscles of ox blood, an acid

albuminate containing iron and phosphorus in organic combination, given in doses of from 1 to 3 teaspoonfuls per diem, is well borne by patients and does not cause gastric disturbance or constipation. It has been found to be a valuable nutrient in anemia and is useful in early tuberculosis.

Anorexia.—This very common symptom generally yields to the open-air treatment and no medication is required. Temporarily, however, some artificial aid to the appetite may be indicated, and some of the tonics mentioned above, or the remedies referred to under specific medication, may serve the purpose, or a little alcohol in the form of wine or beer taken with meals; or a bitter, like Vermouth, tincture of nux vomica, or gentian, before meals. The main reliance, however, must be fresh air and a careful selection and preparation of the diet. A solution of persulphate of soda, known as "persodin," is recommended by Robin and others as of value in increasing or bringing back the appetite as well as improving the digestive powers; it is given in doses of a tablespoonful once a day before breakfast. Burton-Fanning[1] recommends the following as particularly useful, both in increasing the appetite and remedying various digestive disturbances, such as flatulence, distention, and pyrosis:

℞. Sodii bicarbonatis.....gr. xv (1 gm.)
Tincturæ nucis vomicæ.....mvij (0.4 gm.)
Tincturæ gentiani.....ʒss (2.0 c.c.)
Aquæ chloroformi.....ad ʒj (30.0 c.c.).—M.
Sig.—The above at a dose before meals. It can be continued for a long time.

Digestive Disturbances.—These are to be treated according to the indications, very much as in other diseases—the main reliance is upon a proper selection and adjustment of the food to the patient and the especial condition. If there is a sensation of weight and distention after eating, pepsin with bismuth dermatol, naphthol, or some similar antifermentative may be prescribed. *Orexin*, first recommended by Penzoldt, has been used with success, not only as a corrective to delayed digestion and various functional digestive disturbances, such as heaviness after meals, gastric distention, and flatulence, but as a gastric stimulant, thus exciting the appetite. It is almost innocuous, and can be continued for a long time without bad effect. It is odorless, tasteless, and hence easily administered. There are three forms which are used therapeutically: (*a*) Basic orexin; (*b*) orexin hydrochlorate; (*c*) tannate of orexin. The dose of each is the same, which is $1\frac{2}{3}$ gr. (0.1) at the beginning, twice a day, two hours before the principal meals, in powder or tablets with a half-glass of water, milk, or both. If this quantity is well borne, the dose may be gradually increased to 5 or 8 gr. (0.3–0.5) twice a day, or $\frac{1}{2}$ gr. (0.025) for five days; then a five-day intermission, and again resume.

Somatose, a yellow powder containing albumose with a small amount of peptone, has been found useful both as a food and gastric stimulant, relieving the various functional dyspeptic symptoms incident to the gen-

[1] Open-air Treatment of Pulmonary Tuberculosis, p. 124, 1905.

eral weakness accompanying the disease. It is administered in doses of 4 to 8 teaspoonfuls (15–30 c.c.) a day for adults, and 45 gr. to 2½ teaspoonfuls (3–10 c.c.) for children in milk, soup, or cocoa. It may also be combined with eggs or other albuminoids. It sometimes produces gastro-intestinal irritation with diarrhea. *Alcarnose*, *tropon*, and *globone* are other similar preparations. When the normal digestive ferments are defective in activity and deficient in quantity, besides the tonics—pepsin, hydrochloric acid, or alkalis—the various predigested foods are available, the most commonly used and probably the most useful of which is peptonized milk. Diastase, which is contained in the various malt preparations in a greater or less amount, is best exhibited in the form of *taka-diastase*, dose, 1 to 5 gr. (0.06–0.3), and is valuable in the indigestion of starchy foods and in atonic dyspepsia; in the latter case Hare recommends the addition of a little capsicum. Often frequent feeding in small quantities may be effective in administering the requisite amount of food and avoiding digestive disturbances. Care must be taken to keep the bowels open, and occasionally a mercurial laxative is useful. In the irritable condition of the stomach which frequently occurs in the later stages of the disease, which is indicated by a red tongue, with pain after eating, acid eructations, and an inclination to nausea and vomiting, bismuth, either alone or combined with a little codein, is serviceable. The greatest care also should be taken with the diet, which should be easily digestible and unirritating, such as milk with some alkali, chopped beef, beef-juice or essence, malted milk, etc. Ransome considers that the quickest way of giving relief in this condition is a pill of 1½ gr. of calomel and ½ gr. of opium at bedtime, or if constipation is present, 1½ gr. of pulverized ipecac comp., with the same dose of calomel, and after this bismuth with dilute hydrocyanic acid and an alkali.[1] In the chronic gastritis of the advanced stage of the disease the medicinal treatment can be only symptomatic. The two most useful drugs are bismuth and opium, preferably in the form of codein; here, again, the nourishment must be of the most delicate kind—peptonized milk, kumiss, soups, beef-tea or extracts, eggs; some form of alcohol is also usually necessary.

Vomiting.—This symptom is caused either reflexly by cough or from irritability and excessive sensitiveness of the pharynx, or directly by gastro-intestinal disturbance. If the cough is the exciting cause, its treatment is the treatment of the cough and will be discussed at length later. Vomiting occurs perhaps more frequently than any other time on taking the morning meal—the food excites coughing and the coughing results in vomiting. This may be obviated by taking a warm demulcent or alkaline drink on awaking, such as Apollinaris or Vichy water, hot milk with an alkali, a little hot whisky and water, a cup of coffee or beef-tea. The warm drink facilitates the inevitable morning paroxysm of coughing and the consequent expectoration, and later the breakfast can be safely taken. If the pharynx is inflamed and irritable, and the contact of food with its surface appears to be the exciting cause of the cough and vomiting, local treatment is indicated,

[1] The Treatment of Phthisis, Ransome, 1896.

as the application of a cocain solution cautiously used or orthoform just before the meal. A frequent cleansing of the mouth and pharynx with some alkaline solution and care of the teeth are important prophylactic measures in this connection. If the reflex cough and vomiting seems to be caused by the contact of food with the gastric mucous membrane, various gastric sedatives are indicated, such as chloroform-water, oxalate of cerium, basic orexin—5 gr. (0.3), in capsules or chocolate tablets, an hour before meals—or codein. A warm alkaline drink just before eating may here again act as a preventative, or a little alcohol in some form with an alkali, such as effervescing soda, Apollinaris, or Lithia water. Cornet suggests the following:

℞. Tincturæ iodini,
Chloroformi.....āā ʒi¼ (5.0 c.c.).—M.
Sig.—Five drops in water at meals, night and morning.

Or a pill of ⅙ to ¼ gr. (0.01–0.015) nitrate of silver one-half to one hour before meals. If disturbed or impaired digestion is the direct cause of the vomiting, this is to be treated as has been indicated above.

Diarrhea.—This may be caused by ordinary digestive disturbances or from a tuberculous involvement of the intestinal tract. In the former case the treatment should be by a change of diet—for a day or two the diet should consist of milk and milk foods with toast—first cleansing the alimentary tract with a dose of castor oil or calomel. If further medication is needed, one of the following may be used—bismuth salicylate, which Burton-Fanning[1] considers "our best remedy for diarrhea," and useful also when there are pain and catarrh. He suggests the following method of administration: The patient is supplied with pure powder, from which he measures out a level teaspoonful (about 20 gr.); this he places on the side of his plate at each meal, and eats with successive mouthfuls of food, like salt. Tannigen, 8 to 15 gr. (0.5–1) three or four times a day; tannalbin, 15 to 30 gr. (1–2) several times a day.

℞. Methylene-blue (Merck).....gr. iij (0.18 gm.)
Lactose.....gr. xx (1.25 gm.).—M.
Sig.—In wafer or capsule, one each day.

In the diarrhea of tuberculous ulcerations some of the above remedies may also be tried, or the following: Oxid of zinc with bismuth, lead and opium pills, fluidextract of coto bark in 5-minim doses; sulphate of copper, enemata of starch and opium, alternating with nitrate of silver enemata or collargol, which is only slightly irritant and is an active antiseptic. Müller[2] speaks highly, from an extensive experience, of irrigation of the rectum in whatever portion of the intestines the ulcerations may be; subsequent to the irrigation he applies, per rectum, bismuth subnitrate in suspension; this procedure must be continued for a long time. Great care must be taken with the diet, which should consist of milk, arrowroot, milk puddings, custards, or meat, etc. Stimu-

[1] Open-air Treatment of Pulmonary Tuberculosis, p. 124, 1905.
[2] Handbuch der Therapie der chronischen Lungenschwindsucht, Schröder and Blumenfelt, p. 729, 1904.

lants are generally indicated in this condition—brandy, whisky, or champagne.

Cough and Expectoration.—The symptom of cough, which from its prominence the patient so frequently regards as the disease itself, is too often treated by the easy and elusive method of drugs to the undoing of the digestion. The fundamental treatment of the cough is comprehended in the open-air management of the disease, and if this is rigidly carried out, the cough, in the majority of cases, will take care of itself. It is a common experience in sanatoria that with the open-air life the cough practically disappears in a comparatively short time. The training of the patient to restrain all useless unproductive coughing is, moreover, an essential factor in the treatment of this symptom. Dettweiler used to tell his patients that it was as rude to cough in public as to scratch one's head, and he would not permit a coughing patient to come to the general dining table. The writer recalls more than one meal taken in the general dining-room of German sanatoria when hardly a cough was heard during the whole meal. Lalesque's method of controlling cough by discipline is as follows:[1] "Just at the moment when laryngeal irritation ending in a dry cough is noticed, the patient must gently close the mouth and make a series of inspirations through the nostrils; these inspirations must be deep, slow, and calm, and should be continued until the laryngeal irritation ceases. After a few days' practice the patient will be able to suppress the dry, useless cough, and in future will only cough in order to expectorate." Unfortunately, the majority of tuberculous patients cannot be treated in a sanatorium or at home under ideal open-air conditions, where the treatment and training can be strenuously carried out, and hence, to one's regret, drugs to a greater or less extent may have to be employed in dealing with cough. Moreover, certain classes of patients *insist* upon having some medicine for their cough, for they cannot be disabused of the idea that the cough is a disease, and if this is allayed, they feel that they are improving; therefore, even for the mental effect, some cough remedy may be deemed advisable. One should not, however, prescribe in a routine or haphazard manner an expectorant or anodyne cough mixture; in each case an attempt should be made to determine the exciting cause—the pathologic condition producing the symptom. Again, one must decide whether the cough or the remedy will produce the most harm; for example, Will the proposed remedy interfere with nutrition by upsetting the appetite and digestion? and if so, Is an alleviation of the cough worth the sacrifice of one of the fundamental conditions of cure—efficient nutrition? On the other hand, the cough may be so insistent and harassing that it exhausts the patient by day and renders his nights sleepless. In this case it is the cough which is killing him, and it must be controlled at whatever risk to other functions. Let it be repeated, however, that first of all we must, as nearly as the circumstances will permit, place the patient under the conditions which are the most favorable for the disease itself; that is, under the hygienic-dietetic treatment already

[1] New Methods of Treatment, Laumonier, 1904.

discussed under the general management. Roughly speaking, the cough is either effective, for the purpose of eliminating accumulated secretions, ineffective or irritable, or a combination of the two. Our purpose in treatment should be to restrict the cough, so far as possible, to the first kind, namely, a cough for purpose. The morning cough, for the purpose of getting rid of the accumulated night secretions, is to be encouraged and made as short and easy as possible; this may be accomplished by a hot drink, as mentioned under Vomiting. When the secretions are tenacious, and it requires much effort to dislodge them, an expectorant-like chlorid of ammonium, or aromatic spirits of ammonia, or warm alkaline waters, or even plain warm water, a moist atmosphere, inhalations of moist salt water or terpinol, eucalyptol, oil of pine needles, or terebene, are useful. In the irritable, dry, hacking cough, effort should be made to discover the cause. If the upper air-passages appear to be inflamed, these can be locally treated with sprays of menthol, myrrh, alkaline solutions, etc., or the pharynx may be painted with the following:

℞. Iodini.....gr. i$\frac{3}{4}$–v (0.1–0.3 gm.)
Potassii iodidi.....gr. xvj–xlviij (1.0–3.0 gm.)
Glycerinæ.....ʒij, gr. xl (10.0 gm.).—M.
Sig.—Apply every day or every second day.

Again, the cause may be pleuritic, and counterirritation or strapping of the affected side may afford relief. If the nervous element appears to be the prominent cause, nervous sedatives are indicated; or if gastric irritability is decided to be the exciting cause, bismuth and other appropriate remedies for this condition are to be tried.

We shall often, however, be unable to discover any adequate cause for the cough other than a general irritability of the respiratory passages, and such means must be employed to mitigate it as will least disturb the digestion. We can try, at first, such simple remedies as acacia, gelatin, or lactucarium pastils, demulcent drinks, as sea-moss or flaxseed tea with lemon-juice, and others, which will occur to one. Sooner or later, however, recourse to more positive anodyne medication will be demanded, and probably the best for this purpose are the three derivatives of opium —codein, heroin, and dionin. Of all the opium preparations, these three are the least objectionable as regards disturbing the digestion and nutrition. They are best administered in capsules, tablets, or a watery solution, in the following doses:

Codein.....gr. $\frac{1}{4}$–$\frac{1}{2}$ (0.01–0.03);
Heroin.....gr. $\frac{1}{24}$–$\frac{1}{12}$ (0.0025–0.005);
Dionin.....gr. $\frac{1}{6}$–$\frac{1}{2}$ (0.01–0.03).

Nagelsbach gives the following prescriptions:

℞. Codein phosphatis.....gr. $\frac{1}{2}$–$\frac{3}{4}$ (0.03–0.045)
Spiritus vini.....ʒi$\frac{1}{4}$ (5.0)
Aquæ destil.....ad ʒij (64.0).—M.
Sig.—Teaspoonful from one to three times a day.

℞. Dionin.....gr. $\frac{1}{2}$–$\frac{2}{3}$ (0.03–0.04)
Aquæ destil.....ʒiss (45.0)
Aquæ amygdalæ.....ad ʒij (60.0).—M.
Sig.—Teaspoonful at night.

A dose of one of the three sedatives half an hour before bedtime, to be repeated once or twice during the night if necessary, will generally secure a comfortable night's rest. Other sedative remedies are gelsemium, chloroform, hydrocyanic acid, and belladonna. If the expectoration is excessive, creosote or some of its derivatives is perhaps the most effective drug for this condition. "No remedy," says Latham, "removes the accumulated secretions so effectively and with such benefit to the patient as creosote in the form of vapor." This can be done by means of a perforated zinc inspirator, fitted over the nose and mouth, containing a sponge upon which the drug is placed. Other drugs are terpin hydrate, 2 to 3 gr.; terpinol, 2 gr. in capsules; eucalyptol, 3 to 8 gr. in capsules, or the following formula (Laumonier):

℞. Eucalyptol,
Essence of turpentine,
Creosote.....āā ʒv (20)
Ether.....ʒi¼ (5).—M.
Sig.—Use by inhalation.

Gominol has been highly praised, used as follows, 4 gr. (0.26) in capsules, four to ten a day, or subcutaneously, thus:

℞. Pure gominol.....ʒiiss (10)
Sterilized olive oil.....ʒx (40 c.c.).—M.
Sig.—Begin with 15 minims (1 c.c.) and gradually increase to ʒiiss or even ʒv (10–20 c.c.).

The gominol can also be used by inhalation, as in the above formula, the eucalyptol being replaced by the gominol. It is said to diminish the cough, expectoration, and dyspnea.

Benzoic acid, 10 to 30 gr. (0.6–2); compound tincture benzoin, 30 to 60 minims (2–4); balsam copaiba, 20 to 60 gr. (3–4), are other remedies of a similar nature.

In the last stages of tuberculosis opium will have to be used, but always judiciously.

Fever.—As with the cough, the fever will generally disappear under the open-air treatment and rest, and no further treatment for it is usually necessary. The importance of absolute rest for fever patients has already been insisted upon—a temperature of 100° F. or over means *rest.* The patient can either remain in bed in his room with open windows, in a reclining chair on the veranda, or by an open window.

The diet in fever must be adjusted to the patient's condition; if this is good, the ordinary diet of solid food can be given. "The more solid food the patient can take," says Latham, "the sooner will his temperature decline." If there is disturbed digestion and anorexia, easily assimilable food in small quantities and at frequent intervals is indicated. Such articles as milk and its various preparations, eggs, soup, chopped meat, meat jellies, beef-juice, and meat extracts are available.

The use of alcohol in fever is to be decided on individual indications. Brehmer valued it highly as a fever remedy, employing as his favorite form strong Hungarian wine. If used, the most opportune

time of its exhibition is at the beginning of the rise of temperature, to be repeated when the same condition recurs. Brehmer also gave it to prevent the chill which frequently ushers in the fever—a glass of warm whisky and water or mulled wine an hour before the expected chill, keeping the patient carefully covered up.

Antipyretics are to be avoided, if possible, such as phenacetin, sodium salicylate, antipyrin, antifebrin, etc.; they are depressing, have only a transitory effect, and should not be employed. If any drug is used, pyramidon, which is highly extolled by the Germans, appears to be the most useful and the least harmful antipyretic. It is administered in doses of 2½ to 5 gr. (0.15–0.3) or more in capsules or solution; if by the latter method, a powder is to be dissolved in a glass of water, which is to be slowly sipped during an hour, and taken from three to six hours before the expected rise of temperature. Moeller considers it a specific for the fever of tuberculosis, and Saugman[1] says that the cases of tuberculous fever which are not favorably influenced by pyramidon are few. It can be used for a long time. Even with this apparently excellent antipyretic one must never forget that the main remedy is "fresh air night and day before everything else" (Ransome).

Cryogenin, dose, 5 to 15 gr. (0.3–1.0), is a favorite antipyretic with the French, resembling pyramidon in its action, and is said to have a more permanent effect than many of the other remedies of this character.

The comfort of the fever patient is much increased, and possibly some favorable influence is exercised upon the fever, by sponging with tepid or cool water and toilet vinegar or eau-de-cologne several times a day. In certain cases of fever, where, besides the tubercle bacillus, there are other various micro-organisms, such as the staphylococcus, pneumococcus, streptococcus, and others, the writer has sometimes found an autogenous vaccine successful in reducing the temperature as well as mitigating other symptoms, and it has not been found productive of any injury.

Night-sweats.—If the open-air treatment is thoroughly carried out, this disagreeable symptom readily disappears or does not occur, and drug treatment for it is rarely necessary.

Schröder says that for many years he has given no drugs for this symptom in his sanatorium, and, indeed, under the hygienic treatment night-sweats may be said not to exist. Night-sweats and fever usually occur together, and the common cause is probably the absorption of the toxins of the tubercle bacilli or of the secondary bacteria. The patient should occupy a well-aired large room, with open windows, and have only sufficient bed-clothing of light weight to be comfortable. Cornet and Saugman recommend that the arms should be kept outside the coverlid.

On going to bed a glass of cold milk, with one or two teaspoonfuls of brandy, as recommended by Brehmer, may be taken, and during the night something simple to eat, as bread and butter, etc.

When sweating occurs, the patient must be rubbed dry under the

[1] Handbuch der Therapie der chronischen Lungenschwindsucht, p. 379, 1904.

bed-clothes and his linen changed. The patient may also be bathed at night with cool water and alcohol, brandy, or vinegar, followed by powdering with starch, or tannoform 1 part and talcum 2 parts.

Of drugs, the following are the most reliable: Camphoric acid, 20 to 30 gr. (1.3–2) in capsules, an hour or two hours before going to bed; guaiacamphol, 3 to 7 gr. (0.2–0.45) or more at night; agaricin, $\frac{1}{10}$ to $\frac{1}{3}$ gr. (0.006–0.02) in pills or powder, given several hours before the expected sweating; agaricinate of soda or lithia, 2 to 4 gr. (0.1–0.25), taken between 8 and 9 P. M. in half a glass of water; picrotoxin, $\frac{1}{60}$ gr. (0.004); atropin, $\frac{1}{100}$ gr. (0.0006), both at bedtime. Moeller[1] speaks well of bromural, dose, 5 gr. (0.3), as an antihydrotic, and it is also of value, he says, in controlling the fever and cough.

Before having recourse to any medicinal treatment one should try to produce the desired effect by the open-air life, a rearrangement of the hygienic conditions, the bedroom, bed-clothing, etc., or if the patient has been up and about, he should be put to bed.

Hemoptysis.—This can occur at any stage of the disease, but more frequently, however, in the early and later stages. In the first it is generally regarded as the result of hyperemia or the ulceration of a capillary vessel; in the latter, from the rupture of an aneurysmal dilatation of a large vessel in a cavity. There are but few fatal cases of hemorrhage except those from the rupture of an aneurysm.

Prophylaxis.—Every tuberculous individual has the possibility of a hemorrhage, and should, therefore, be cautioned against sudden or severe physical or mental exertion, such as loud screaming, singing, excessive unrestrained coughing, pulmonary gymnastics without careful supervision, and excess in drinking and eating. It would be well to determine from time to time the blood-pressure in patients with a tendency to hemoptysis as a guide in regulating their mode of life.

In the treatment of hemoptysis the principle, upon which the control of the hemorrhage has been attempted is: First, by the reduction of the blood-pressure; second, by increase in the coagulability of the blood through mechanical or chemical means; third, by contraction of the blood-vessels of the lungs. Practically, in active medication our efforts are directed toward the lowering of the blood-pressure. Drugs employed to increase the coagulability of the blood have not been very successful, while those which are supposed to cause contraction of the blood-vessels have been generally discarded as not only being in most cases without effect, but absolutely harmful, for it must be remembered that the blood-vessels in the diseased area have undergone degenerative changes which render them more or less incapable of contraction. Our efforts, then, as has been stated above, are directed toward lowering the pulmonary tension by reducing the blood-pressure. When the hemorrhage is slight, it may be only what we call streaked sputum. All that is necessary is to reassure the patient and keep him quiet for a few days, and, in addition, see that the bowels are kept open by some saline laxative, such as one of the laxative mineral waters or Epsom salts. It must

[1] Lehrbuch der Lungen-Tuberkulose, 1910.

be remembered, however, that a slight hemorrhage may be the precursor of a more severe one, and hence the wisdom of keeping the patient at rest. If the hemorrhage is more severe and every attack of coughing is accompanied by more or less blood, more active measures are indicated. The patient is put to bed with his shoulders raised and kept absolutely quiet and forbidden to speak, and immediately given, by inhalation, nitrite of amyl, which is best exhibited by means of glass pearls or "spirets" containing 3 or 5 minims, which are broken upon a handkerchief or cloth, liberating the fumes of the drug, which are inhaled by the patient. This can be repeated, if necessary, within a few minutes, although Abrams [1] says that unless the drug is efficient after the first inhalation, it is usually without any action.

The employment of the nitrite of amyl is based upon the fact of its physiologic effect in producing an immediate fall in the blood-pressure, which is what we desire to accomplish. If the patient cannot inhale the nitrite of amyl, as sometimes happens, or if the blood recurs or persists, one of the other nitrite preparations which have a more lasting effect may be used—either sodium nitrite (gr. j) or nitroglycerin, $\frac{1}{100}$ or $\frac{1}{50}$ gr. given hypodermically, and repeated according to the necessity, or it may be given by the mouth in $\frac{1}{50}$-gr. doses. Hare, of Australia,[2] states that in 60 cases treated by himself and others, in every instance except one the bleeding ceased immediately or became reduced to a mere streak of the sputum, that is, within a minute or two, upon the use of the nitrite of amyl, and that no other drug was employed. At the Massachusetts State Sanatorium, in the service of the writer, nitrite of amyl was employed as a routine measure in most cases of hemoptysis, the blood-pressure being taken as a guide, the nurses being trained to do this. If the bleeding recurred or persisted, one of the other nitrites was given as before indicated. In order to allay the nervous excitement and cough and equalize the circulation, a subcutaneous injection of morphin, $\frac{1}{8}$ to $\frac{1}{4}$ gr., or codein, was given in many cases, which can be repeated at regular intervals so as to keep the patient gently under its influence; in fact, rest and opium, as used above, is all the treatment that has usually been employed by a large number of practitioners, and in the majority of cases of hemoptysis it has been effective.

It is a general observation that the majority of cases of hemoptysis occur or recur at night or in the early morning hours, due, as Brown[3] thinks, to certain variations in the blood-pressure. Brown, therefore, gives morphin and sodium nitrite hypodermically between midnight and 2 A. M. in such cases.

The diet in cases of hemoptysis should be non-stimulating and cold—iced milk, soup, ice-cream, gelatin preparations, albumin-water, wine jellies, etc. No examination of the lungs, of course, should be made. In all cases the bowels should be kept open by saline aperients or other

[1] Spondylotherapy, 1910, p. 315.
[2] British Journal of Tuberculosis, vol. i, p. 55.
[3] Transactions of the Second Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, 1906, p. 459.

laxatives, and if constipation exists, an enema of olive oil and soap-suds or a good dose of castor oil may be the most effective. It has rarely happened that a hemorrhage in the early stages of the disease has proved fatal or excessively severe, but, as a result of the hemorrhage, new areas of disease may result, or a septic bronchopneumonia may occur, which is a very serious complication. Every effort, therefore, should be made to avoid such untoward complications by the most careful nursing, fresh air, and, above all, by absolute rest. The patient should not be permitted to use his arms, even to help himself; no visitor should be allowed which would tempt him to speak. In very severe hemorrhages, as from the rupture of an aneurysm, the treatment is somewhat different, for here we are face to face with a most serious condition, which may prove almost immediately fatal. The patient, of course, should be kept absolutely at rest in a recumbent position in a well-ventilated room, the bed-clothes light, and an ice-bag applied to the cardiac region or cold compresses to the chest, being renewed every half minute or minute. The one drug which seems to be most efficient in these severe cases is sulphate of atropin, given subcutaneously in doses of $\frac{1}{50}$ gr. or even as large as $\frac{1}{25}$ gr. With the atropin may be combined $\frac{1}{4}$ gr. of morphin, although one must remember that the morphin may blunt the sensitiveness of the air-passages and the effused blood may remain in the lungs, leading to bronchopneumonia. The old procedure of applying constriction to the extremities is highly extolled by Weismayr, Moeller, and others, and it seems a simple and reasonable procedure. With a bandage, a piece of cloth of any kind, such as a towel, pillow-case, or sheet, or rubber tubing, one binds first one thigh and then the other, and, if necessary, the arms in a similar manner. After a half-hour or an hour, the constriction bandages may be removed, but gradually and one at a time. The application of adhesive plaster for the purpose of constricting the diseased half of the chest, if the disease is unilateral, is regarded by Bridge and others as a measure of much value. The plaster is applied in overlapping strips so as to restrict the movements of the diseased side, leaving the other side free in its movements. If the patient is in immediate danger of collapse from excessive loss of blood, the infusion of physiologic salt solution is indicated, and under these exceptional conditions a stimulant, such as aromatic spirits of ammonia or champagne, may be necessary to keep alive the patient. When the blood fills the bronchi and upper passages and threatens to drown the patient in his own blood, coughing and deep breathing should be encouraged and the finger may have to be used to dislodge the clots. It may be necessary, however, to administer an emetic—apomorphin, $\frac{1}{40}$ gr. (0.006) hypodermatically—to aid in accomplishing this. Morphin, if used at all in these extreme cases, should be employed with great caution. After the hemorrhage has ceased, the patient should be kept in bed as long as the sputum is colored, and only very gradually, often after weeks, be permitted to take any exercise.

Many other drugs have been employed and recommended in the treatment of hemoptysis; thus, Moeller and others speak highly of

oleum terebinthinæ, 6 to 8 drops on a lump of sugar six or eight times a day, or terpinol, used in the same way. Calcium chlorid or lactate is a drug which has been considerably employed upon the principle of increasing the coagulability of the blood, but it does not seem to be of very great value. The chlorid of calcium is the most efficacious, while the lactate is the most agreeable. The dose of the two preparations is from 10 to 20 gr. or even more, given, first, every two or three hours for three days, and if effective, the dose is reduced and given at longer intervals.

Gelatin has also been employed for the same purpose, used subcutaneously in sterilized solutions or by the mouth in tablets containing from 45 to 60 gr. (3 to 4 gm.)—twenty in a day. If used at all, it will probably do as much good in the form of gelatin food preparations. Adrenalin is highly recommended by Coleman,[1] who employs it either as such or the suprarenal extract as a routine measure in hemoptysis. It is difficult, however, to explain the favorable action of this remedy upon hemoptysis from its known physiologic effect, which is to increase the blood-pressure, but, as Bridge remarks, this substance may possibly have some other power over hemorrhage. If the adrenalin chlorid is employed, 20 to 30 drops of a normal salt solution, 1 : 1000, may be given every two, three, or four hours, or 15 to 25 drops subcutaneously and repeated if indicated. If the suprarenal extract is employed, 3 to 5 gr. may be given every half-hour for three days, then every two hours for three days, and, finally, three times a day for a week or as long as the sputum is streaked.

Walters[2] speaks of restricting the quantity of liquids in the diet as reducing the vascular tension, and says that this method is very efficacious in recurring hemorrhages. Common salt, an old remedy, still has its advocates. A half-teaspoonful can be given dry on the tongue or dissolved in a little water. Aconite, digitalis, and the inhalation of styptics, such as gallic and tannic acid, alum, and liquor ferri subsulphatis, and other remedies have been employed at one time or another, but are not to be recommended.

Ergot has long been one of the principal drugs employed in hemoptysis, and sometimes after its use the hemorrhage ceases, but, as Babcock says, "it is probably a case of post hoc propter hoc." If has evidently had its day and is now generally discarded. "There is in the whole range of professional experience," says Bridge,[3] "hardly a more striking example than this of the frequent prescribing of a potent drug with an effect the exact opposite of what was intended." Finally, in a word, the best treatment for hemoptysis, in the writer's opinion, is, first, rest in bed; second, the inhalation of 3 to 5 minims of nitrite of amyl or the nitrite of sodium, 1 gr., or nitroglycerin, $\frac{1}{100}$ or $\frac{1}{50}$ gr.; third, morphin, subcutaneously, $\frac{1}{8}$ to $\frac{1}{4}$ gr., which may be used in conjunction with the nitrite or alone; fourth, for excessive hemorrhage, $\frac{1}{50}$ to $\frac{1}{25}$ gr. of atropin subcutaneously; fifth, saline laxatives, if necessary, cracked ice to suck,

[1] Klebs, Tuberculosis, 1909, p. 633.
[2] The Open-air Treatment, 1909, p. 267.
[3] Tuberculosis, 1903, p. 274.

and an ice-bag over the heart, moderate or light diet of cold food composed of simple articles as before indicated. The application of these and other means must, however, be made discriminately according to the indications in each individual case.

One word with regard to the interpretation and value of an initial hemoptysis. In the vast majority of cases a hemoptysis is the result of tuberculosis, whether or not corroborative evidence is found in a physical examination of the lungs, and it is to be so considered unless clear evidence is at hand that the bleeding is from another source. Furthermore, an initial hemorrhage is of the highest value in giving us an early diagnosis and enabling one to institute early treatment. Moreover, it is a visible evidence to the patient that our diagnosis is correct, and puts him in a willing attitude to carry out the appropriate treatment (the hygienic-dietetic) without delay.

Pain is a frequent symptom in the course of pulmonary tuberculosis, and its treatment will depend upon the cause, if discoverable, which is not always the case. If due to pleuritic inflammation in the lower part of the chest, immobilization of the chest-wall by strapping with adhesive plaster gives the quickest and most effective relief. If the pleurisy is in the upper part of the chest, where the strapping cannot be applied, counterirritation is available. Abdominal pain from incessant coughing is relieved by treatment of the cough. A snug abdominal bandage is useful in this case. Neuralgia, rheumatic pains, and others of indefinite origin must be treated by local applications of liniments, warm compresses, massage, electricity, etc.

Insomnia.—The cough is perhaps the most common cause of sleeplessness, although it is an accompaniment of many of the other symptoms—sweating, fever, pain, general weakness and discomfort, etc. If from cough, whatever will relieve that will relieve the insomnia, and generally some form of opium will be necessary—heroin, codein, or dionin—as mentioned above. If from other causes, they must receive appropriate treatment. Open air is the best general hypnotic and is usually sufficient. There are many simple expedients which will aid—a quiet, restful evening, a glass of hot malted milk, a glass of beer or ale, or a light meal at bedtime. The bedroom should be quiet, well ventilated with open windows, and darkened. Bed shoes, woolen stockings, a hot-water bag, or wrapping the feet in flannel are indicated if the feet are cold, for one cannot sleep with cold feet. If other means fail, some of the hypnotics may be necessary, but they should be used with circumspection and only intermittingly. Veronal, 5 to 15 gr. (0.3–1 gm.), in capsules, or trional, 10 to 15 gr. (0.6–2 gm.), in hot bouillon, tea, or whisky, are the two best hypnotics. As a last resort, codein, ½ to 1 gr. (0.03–0.05 gm.), or tinctura opii camphoratæ, 1 to 2 teaspoonfuls (4–8 c.c.), may be effective.

Dyspnea.—In the advanced stage of the disease dyspnea is a distressing symptom, a result of the extensive invasion of the lungs, and the consequent reduction of the vital capacity. The only treatment is a reduction of the respiratory demands to the smallest compass, and

consequently absolute rest should be enjoined and every exertion avoided. Temporary relief may be obtained from some of the diffusible stimulants, such as aromatic spirits of ammonia, Hoffman's anodyne, brandy, and from the inhalation of oxygen gas. Strychnin is also of value for this condition. The following has also been recommended by Jacobson, Schroeder, and others. Oxycamphor, 8 gr. (0.5 gm.), in powders three times a day, or—

℞. Oxaphor.....ʒij, gr. 40 (10 gm.)
Spiritus vini.....ʒv, ♏20 (20 c.c.)
Syrupi aurantii.....ʒij, ♏40 (10 c.c.)
Aquæ destillatæ.....ad ʒv (150 c.c.).—M.
Sig.—One tablespoonful (15 c.c.) three times a day.

Or,

℞. Oxaphor.....ʒiij (12 min.)
Spiritus vini.....ʒix (36 c.c.)
Syrupi aurantii.....ʒvj (24 c.c.)
Aquæ destillatæ.....ad ʒvj (180 c.c.).—M.
Sig.—Two tablespoonfuls (30 cc.) at a dose.

The bromids are also useful when a nervous element exists.

Eventually one will probably have to employ opium in some form for this condition, which is perhaps the one best remedy.

Last Stage—Hopeless Cases.—Infinite pains is required, both on the part of the physician and the nurse, to render the patient tolerably comfortable during this trying period, and everything which conduces to the patient's relief and comfort is to be allowed. The diet, sick-room, bed, care of the throat, mouth, and tongue, which is often aphthous and painful, the skin, prevention of bed-sores, and, in brief, the innumerable symptoms constantly arising or imagined, require exacting attention, and will tax both the skill and patience of the physician. Stimulants and opium will play an important part in the therapeutics of this stage. If pleuritic effusion occurs, as it frequently does, it is not to be aspirated unless there is imminent danger of a fatal result, for the effusion acts as a splint to the diseased lung, and frequently renders the patient more comfortable and tends to retard the disease, as shown by Loomis, who produced an artificial compression of the tuberculous lung with nitrogen gas. Antistreptococcus serum has been employed in the mixed infection of advanced cases, with the object of neutralizing the streptococci and hence ameliorating the symptoms incident to the secondary bacterial infection; the writer has not, however, met with any success in the use of this serum, but other observers have reported favorable results, notably Bonney,[1] The autogenous vaccines have also been employed for the same condition, with some success at times.

Laryngeal Tuberculosis.—In the vast majority of cases laryngeal tuberculosis is secondary to, or a complication of, pulmonary tuberculosis, although it has been proved that it can be the primary infection.

[1] Four Months' Experience with Antistreptococcus Serum in Pulmonary Tuberculosis, S. G. Bonney, A.B., M.D., Medical News, June 13, 1903.

It is a most distressing complication, especially when there is much swelling and ulceration, and to witness the suffering on attempts to swallow is extremely painful. The general treatment is that of pulmonary tuberculosis—the open-air régime, which is of more value than any remedy. As to a suitable climate, the same principles govern its selection as in pulmonary tuberculosis, which is practically always present. High altitudes have been thought to be contraindicated, but Solly and others have shown that with opportunities for appropriate local treatment this complication does well in the high altitudes. If the case is acute or advanced, a moist, warm, equable climate is indicated, but wherever one goes he should be sure of obtaining skilful local treatment; better this than a change to a more favorable climate, if one must choose between the two.

This does not mean, however, that constant local treatment is either necessary or always wise, for Bonney[1] well remarks that nothing can be more pitiful than to witness advanced and hopeless consumptives dragging themselves to the doctor's office day after day to receive a few moments of laryngologic attention, no matter how skilful or rational the treatment. The general treatment should have the first place, and it is the most important, and should be exactly the same as that for pulmonary tuberculosis, of which it is generally a complication. Rest of the larynx is most essential, and a patient should use his voice but sparingly. He should not smoke or remain in rooms with irritating gases or dust or tobacco smoke. Local treatment depends on the stage and form of the disease, and in mild cases in the incipient stage, little or no medicinal treatment is required. During the catarrhal stage inhalations of volatile substances and vapors may be employed, such as balsam of Peru, tincture eucalyptus, tar, menthol, compound tincture of benzoin, creosote, etc. Moure[2] recommends the following:

℞. Pulverized menthol.....gr. xxx to lxxv (2–5 gm.)
Balsam of Peru.....ʒj–iiss (4–10 gm.)
Tincture eucalyptus.....ʒviij (250 gm.).—M.
Sig.—A teaspoonful in ½ liter of hot water for inhalation five or ten minutes morning and night.

Or this:

℞. Benzoate of soda.....gr. xc (6 gm.)
Resorcin.....gr. lx (4 gm.)
Glycerin.....ʒxj (44 gm.)
Cherry-laurel water.....ʒxiij (52 gm.)
Aquæ destillatæ.....ʒxiv (400 gm.).—M.
Spray.
Sig.—Use twice a day for five minutes.

Or the following (Lake):

℞. Chloroform.....ʒj (4.0)
Tincturæ benzoini compositi.....ad ʒj (30.0).—M.
Sig.—For inhalation.

[1] Pulmonary Tuberculosis and Its Complications, 1908.
[2] Pharynx and Larynx, 1909.

Beverly Robinson strongly advocated the persistent use of the perforated zinc inhaler charged with equal parts of creosote, alcohol, and chloroform.

For the relief of pain and dysphagia, the larynx can be sprayed with a ½ per cent. solution of cocain, or in painful deglutition, 2 to 8 per cent. solution of cocain may be employed locally just before eating. Insufflation of orthoform powder is also useful in relieving pain, and its effects last longer than cocain. It also has the added value of being non-poisonous. Eucain and morphin are other sedatives. For the troublesome cough, codein, ⅛ to ½ gr. every three hours, or heroin, $\frac{1}{20}$ to ⅙ gr., may be employed. Of the remedies used for curative effects, lactic acid in a solution of from 5 to 40 per cent. or more, formaldehyd, menthol, iodoform, and some of the silver preparations, such as protargol or argyrol in a 10 per cent. solution, are the drugs most commonly employed.

The present tendency, however, is toward less and milder local medication. Formaldehyd is used in a solution, gradually increasing in strength from ½ to 10 per cent., applied by the physician, the patient having a milder solution—1 : 5000—for home treatment. Menthol is said to have given gratifying results. It can be applied directly to the diseased surface by a laryngeal syringe, in a 15 to 20 per cent. solution, or in weaker solutions with a nebulizer, applied at short intervals. Ballenger[1] thus employs menthol : First, the larynx is cleansed by some detergent solution, such as Dobell's solution or other alkaline cleansing fluids. Second, the parts are insufflated with 3 to 6 gr. of powdered saccharated suprarenal gland. Third, after a few minutes an emulsion of menthol and orthoform, made according to the following formula, is slowly instilled with a laryngeal syringe:

Menthol	1 to 15 parts
Olei amygdalæ dulcis	30 parts
Vitelli ovorum	25 parts
Orthoform	12½ parts
Aquæ destillatæ	q.s. ad 100 parts.

Ft. emulsio.

The relief from pain from this application is said to last several hours and even days, and nourishment is taken with ease. By this method it is asserted that the infiltrations disappear, the ulcerations heal, and there is the further advantage of its being without pain.

Iodoform can be employed either in oily emulsion or by insufflation. In the ulcerative stage the iodoform can be combined with morphin and an astringent, thus (Bosworth):

℞. Morphin gr. x (0.6)
Tannic acid ℥ij (8.0)
Iodoform ℥vj (24.0).—M.

Or:

℞. Iodoform gr. iv (0.24)
Orthoform gr. vj (0.36).—M.

[1] Diseases of the Nose, Throat, and Ear, 1909.

Resorcin, 1 or 2 parts combined with 3 parts of orthoform and applied by insufflation every other day, is said to have very striking effects in promoting the repair of ulceration.

In the ulcerative stage, curetting the ulcerated tissues and the subsequent application of lactic acid or the application of lactic acid alone to the ulceration has long been a recognized method of treatment. It seems, however, to be less employed at the present time, when the emphasis in treatment is laid upon the general hygienic-dietetic treatment, and since the other forms of treatment have been found to produce as good results with none of the discomfort and pain incident to the operative and lactic-acid treatment. If, however, dysphagia exists from excessive infiltration, or great swelling of the arytenoids or epiglottis, operative measures for the removal of some of the diseased tissues may be employed, or the passage of a bougie may give relief. Coleman recommends the application of adrenalin or suprarenal extract for this condition.[1] Wolfenden's method of feeding in difficult swallowing is serviceable. It consists in hanging the head over the side of the bed and then sucking milk or other fluid through a tube from a vessel which is placed at a lower level.

The employment of tuberculin in laryngeal tuberculosis has given good results in some cases and would appear to be a remedy of value. The dose is dependent upon the local manifestations. When a slight hyperemia has been produced, the dose should not be repeated until this disappears, and it is not to be increased until the dose used fails to produce a reaction. Further experience is needed to indicate exactly what we may expect from tuberculin in the treatment of this complication. The evidence so far adduced is in its favor.

Acute Pulmonary Tuberculosis.—One may make two clinical divisions: (*a*) Acute pneumonic; (*b*) acute bronchopneumonic. The treatment of both of these types is essentially that of an acute disease. The patient is to be placed under the best possible conditions to combat the disease; the sick-room should be large and afford an abundance of fresh air; the nutrition sufficient and of an easily assimilable character. High temperature is to be controlled not by antipyretics, but by cold sponging, either with water alone or alcohol or toilet vinegar and water. Other symptoms are to be treated according to the indications. The important point is to maintain the strength of the patient and aid him in recovering his resisting power, with the hope that the acute condition may subside and a chronic state supervene amenable to the open-air treatment. This favorable issue is more likely to happen in the bronchopneumonic type.

Acute General Miliary Tuberculosis.—The treatment of this direful calamity is comprehended in a few words—to sustain the strength of the patient by rest, abundant nutrition, stimulants as indicated, and to treat the symptoms as they arise. The result is almost always fatal, and this fact emphasizes the importance of prevention. To avoid the primary infection by the prophylactic measures already described, and

[1] Klebs, Tuberculosis, 1909.

thus remove the ever-present and possible danger of a general inundation of the blood-stream by the tubercle bacilli from the local lesion, or to promote the encapsulation of the tuberculous focus, when this already exists, by all the means already set forth, is the only sure way to avoid this untoward accident.

TUBERCULOSIS OF OTHER ORGANS AND TISSUES OF THE BODY

The site of the tuberculous lesion in the body depends upon various influences. First, the mode of entrance; if by inhalation, the lungs or bronchial glands may be the first point of attack; if by ingestion, the intestines, mesenteric glands, or tonsils; if through the genito-urinary system from without, the tuberculous lesion will be somewhere in that tract; or if by the skin, we have tubercular nodes and lupus. Second, the distribution of the tubercle bacilli from the original focus, depending upon the lymphatic connections and the ease of transference by the natural channels; if, for example, the original focus is in the tonsils, we may have a secondary cervical gland tuberculosis or a tubercular meningitis, or if the original lesion is in the lungs, we may have a secondary tuberculous pleurisy; if one part of the genito-urinary tract is primarily affected, the infection may extend to other parts by continuity of tissue. So also can the infection be carried to any part of the body from the original lesion by the blood-stream. Third, the point of least resistance—it may be the meninges, bronchial or mesenteric glands in a child, or the lungs in an adult. Fourth, the temporary enfeeblement of an organ or tissue by injury or disease; for example, bronchitis or whooping-cough may predispose the lungs to a subsequent tuberculous infection, or an injury to a joint, to a tuberculous joint, a blow on the hip, to a tuberculous hip-joint, etc.

So it is that tuberculosis may invade any and every part of the body entering upon the domain both of the surgeon and the physician.

The treatment of these various local tuberculoses is twofold, general and local, the latter depending upon the situation of the lesion. The general treatment, wherever the lesion, is substantially the same, and has already been fully set forth under the general management of pulmonary tuberculosis. Modifications, of course, may be necessary, depending upon the location of the lesion, its effects upon the general system, and the age of the individual.

Tuberculosis of the Lymph-glands.—The bronchial, mesenteric, and cervical glands are those most frequently involved, and generally occur in children. As a rule, tuberculosis of the bronchial glands is rarely more than suspected during life, although it is the most common seat of the disease in children. The mesenteric glands are infected through the intestine by means of food containing tubercle bacilli; hence the importance of safeguarding the food of infants and young children. The infection of the cervical glands may occur through many avenues from without, through the nasopharynx and mouth, as the tonsils, carious teeth, and adenoid vegetations; from injuries, burns, and various sources of irritation, such as eczema of the face and scalp, in the

drainage area of the glands; chronic conjunctivitis and otitis, etc. With children suffering from glandular tuberculosis the general hygienic-dietetic method is to be pursued; a residence at the seashore, however, has been found particularly beneficial, and the favorable results obtained at the many seaside sanatoria in England and on the continent, and in our own country at the "Sea Breeze" Home on Coney Island, indicate the value of salt air and salt-water bathing, not only in children suffering from glandular tuberculosis, but as well from bone, joint, peritoneal, and other forms of the disease. The diet should be simple, but abundant and nourishing. There is no specific medication, but various drugs have been found to be useful, such as syrup of the iodid of iron in large doses, 20 to 30 drops for a child of six years, cod-liver oil, the syrup of thiocol, called "sirolin," in doses of a teaspoonful, arsenic, and iron. In the writer's experience no local application to enlarged cervical glands is of much value. Tuberculin in the form of the B. E. has given favorable results in many cases, and Tileston[1] states that "most observers agree that tuberculin is an invaluable remedy" in the treatment of tuberculous lymph-nodes; tuberculin should be administered, however, before caseation has occurred. The Roentgen rays are also highly extolled, and some striking instances of cure have been reported. Operative measures for the removal or curetting of these glands are indicated if—(*a*) they threaten suppuration or rupture; (*b*) if there is no improvement after a reasonable trial of the hygienic-dietetic treatment, or (*c*) if there is a rapid increase of the size of the glands. Extirpation obviously gives the most complete and lasting results if the operation is thoroughly done, and before breaking down takes place.

Tuberculosis of Serous Membranes.—(1) *Tubercular Peritonitis.*—This is not the hopeless disease it was once considered to be, and many cases, as we know now, make a complete recovery. F. C. Shattuck, who analyzed 98 cases occurring at the Massachusetts General Hospital,[2] the end-results of which were known in 57 cases, says that the mortality under medical treatment was 68 per cent. and under surgical treatment 37.5 per cent.; over half of the cases occurred between the ages of fifteen and thirty years and two-thirds were females. He considers the best hygienic surroundings all important. "If," he says, "after a month or six weeks of medicinal treatment, which is symptomatic, the patient fails to improve, or if he earlier seems to be losing ground, surgical interference should be advised." The operation is a simple laparotomy, and irrigation with a sterile normal salt solution—and why a cure should be effected by this means is unknown, and the fact was only accidentally discovered. Yeo[3] reports success under the following treatment. The patient is placed upon a milk diet, and the following prescription given him:

℞. Bismuth salicylate.....gr. xv (1 gm.)
Spiritus chloroform.....ℳxv (1 c.c.)
Tincturæ cardamomæ compositæ.....℥ss (2 c.c.)
Mucilaginis acaciæ.....℥ij (8 c.c.)
Aquæ destillatæ.....ad ℥ss (16 c.c.).—M.
Sig.—The above three times a day.

[1] Boston Med. and Surg. Journal, March 24, 1910.
[2] American Journal of Medical Sciences, July, 1902.
[3] Lancet, March 16, 1901.

He applied opium and iodin liniment to the abdomen, and also rubs freely over the abdominal surface twice a day equal parts of iodoform ointment and cod-liver oil. At the end of a week he discontinues the bismuth mixture and gives the patient a pill containing $\frac{1}{4}$ gr. (0.016) of iodoform and $\frac{1}{2}$ minim (0.03) of creosote; later, if improvement occurs, solid food in the shape of eggs, custard, and fish is given. Here again tuberculin may be tried.

(2) *Tubercular Pleurisy.*—The majority of cases of idiopathic pleuritic effusion are of tubercular origin from a primary focus in the lungs or elsewhere, and the modern methods of investigating the fluid by cytodiagnosis and animal experimentation, etc., are affording evidence of this fact. The treatment is that of pleuritic effusion in general. If the effusion is large, its timely removal by aspiration and a general supporting treatment by hygienic-dietetic method is indicated. In the convalescent stage a change of climate to the altitudes may be of value. As to the time when aspiration should be resorted to, there is a considerable difference of opinion, but in the writer's opinion it should be early and repeated if the fluid accumulates. Delafield[1] expresses his conviction, founded upon an experience with 200 hospital cases, that the only treatment needed for pleurisy with effusion is aspiration, and that this should be done as soon as fluid in the chest is made out. Of course, what has been said above does not apply to the pleuritic effusions in the advanced stage of the disease.

(3) *Tuberculosis of the Pericardium.*—Treatment does not avail much with this form of tuberculosis. The patient should be kept at rest in bed, and a counterirritant may be applied to the pericardium. If indicated, aconite can be employed to decrease the cardiac force, and if life is in danger from the effusion, paracentesis is called for.

(4) *Tubercular Meningitis.*—The meningeal infection may occur from a tuberculous focus in any part of the body, either by means of the lymphatic route or the blood-current. Tuberculous foci in the nose, ear, pharynx, tonsils, mouth, or cervical glands may be the source of the meningeal infection, hence the extreme importance of timely attention to any disease in these localities. Tubercular meningitis is met with most frequently in children under ten years of age and is almost invariably fatal. The treatment is purely symptomatic—a darkened room, diet of milk, broth, and eggs, an ice-cap to the head, sedatives, such as the bromids, chloral, and tinct. opii camph., enemas or laxatives, such as calomel, castor oil, cascara, etc., for the constipation. In certain cases where the disease appears to be localized surgical interference has been tried, and sometimes with apparent success. The operation consists in the withdrawal of the excessive quantity of fluid either by lumbar puncture, trephining, or tapping of the ventricles. From 10 to 30 c.c. of fluid can be withdrawn.

Tuberculosis of the Intestines.—This may occur as a primary affection or secondary to a tuberculous infection elsewhere, as in the lungs, bronchial or mesenteric glands. Behring, Calmette, and others

[1] The Treatment of Pleurisy with Effusion, Amer. Jour. Med. Sci., December, 1902.

consider the intestinal tract as the primary source of infection wherever the tuberculous outbreak may be, and around this question of the intestinal mode of infection the discussion is still active, for it involves the still unsettled question of the infection of man by the bovine tubercle bacilli through milk and meat. When the intestinal tuberculosis is a secondary complication to pulmonary tuberculosis, it generally occurs late in the disease, and has already been referred to. Primary intestinal tuberculosis generally occurs in children, although it can also happen in adults. The treatment consists in rest, good hygienic conditions, a careful regulation of the diet, and control of the diarrhea, and for this latter symptom, salicylate of bismuth, opium, creosote, and salol are perhaps the most useful.

Tuberculosis, as has been said, invades every organ and tissue of the body, but, besides the general hygienic-dietetic treatment, there is little to advise in the way of medication for the other manifestations of the disease not already mentioned.

Joint and bone tuberculosis, that of the genito-urinary system, the kidney, bladder, ureter, testes, Fallopian tubes, ovaries, and uterus, so far as local treatment is concerned, falls rather under the domain of the surgeon than the physician. In all these forms, however, the open-air treatment plays a striking part both before and after operative interference, as Halsted has so well illustrated.[1] When medication is called for, it is, for the most part, palliative and symptomatic. As with glandular tuberculosis, iron, arsenic, cod-liver oil, creosote, and other general tonics are useful.

Tuberculosis of the Skin.—The tuberculous infection may invade the skin through wounds, abrasions, scratches, eczema, and inflammation. Tuberculosis of the skin is not common, the most frequent form being *lupus vulgaris,* which may occur in any part of the body, but is especially prone to attack the exposed portions, such as the nose, lips, cheeks, and hands.

In this form of tuberculosis the general condition should receive the same attention as in the pulmonary or other forms. Outdoor life, good nutrition, sunshine, exercise, and good hygienic surroundings should all be employed to bring up the general health of the patient to a high standard and maintain it there. Tonics may also be necessary, such as the hypophosphites, iron, quinin, cod-liver oil, etc. The curative methods employed are: First, the Finsen light and the *x*-ray; second, tuberculin; third, local applications consisting of mild, stimulating, or destructive substances.

The best results in this obstinate disease have been obtained by the use of the Finsen light and the *x*-ray, and success without disfigurement has been obtained through their use. With the Finsen light the treatment is of long duration, extending over months and even years; furthermore, the treatment is very tedious, occupying an hour daily. With the

[1] Results of the Open-air Treatment of Surgical Tuberculosis, Transactions of the First Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, 1906, p. 281.

x-ray the treatment is shorter, although this is a matter of months. The exposures are also shorter—of from ten to twenty minutes. In cases extending over a large area involving the greater part of one or both cheeks with ulceration, the *x*-ray, either alone or in combination with the Finsen light, appears to give the best results.

Morris and Dore, of London,[1] consider that in their opinion ulcerative lupus of limited extent affecting the face and especially in untreated cases, the Finsen light has its greatest sphere of usefulness. With the Finsen light, lupus nodules disappear, while with the *x*-ray there is great difficulty in eliminating them. The expense of the Finsen light is an obstacle to its use, and for this reason, and the comparative rarity, except in large centers, of having access to it, the *x*-ray treatment will be more generally practical.

Beck[2] advises the removal of all broken-down tissue by the scissors or sharp spoon, if it can be readily done, before irradiation by the *x*-ray is begun. In this way, he says, the final result is obtained more quickly and safely. The sittings should not last longer than fifteen minutes. When a reaction occurs, which is shown by swelling and hyperemia, the treatment is temporarily intermitted. Applications can be made daily or every second day until reaction occurs, or the intervals may be longer; according to Williams, not oftener than twice a week at the beginning, and of ten minutes' duration. The healthy portion of the face is protected by a mask of sheet lead, tin-foil, or pasteboard, covered with several thicknesses of gauze. The effect of the *x*-ray is a hyperemic or inflammatory action set up in the diseased area. The *x*-ray light should be intense, and the distance, according to Beck, from 4 to 2 inches, a tube of medium hardness being used.

So far as present experience goes, lupus seems to react poorly to tuberculin. It can be employed according to the common clinical method, or, beginning with a small dose, the subsequent doses can be regulated by means of the opsonic index of the blood.

There are many local applications which have been used and are recommended by various dermatologists. Such are oleate of Hg, salicylic acid, 10 to 20 per cent., dissolved in collodion or in a plaster mass, 1 to 2 drams to the ounce; resorcin employed in the same way; pyrogallic acid, which, according to Stelwagon, is best employed in the form of an ointment, thus:

℞. Pyrogallic acid.....ʒii–iij (8.0–12.0)
Vaselin,
Resin.....āā q. s. ad ʒj (32.0).—M.
Unguentum.
Sig.—Spread on lint or other suitable material and apply, changing twice a day.

Other drugs of a caustic nature are arsenic, used in the form of an ointment or paste and lactic acid. Curetting and cauterization have also been employed. None of these methods of local application, however, have been very successful in effecting a permanent cure, and the *x*-ray or the Finsen light still remains the most successful method of treatment.

[1] Tuberculosis, Leipsic, vol. iii, No. 10, 1904.
[2] Röntgen-ray Diagnosis and Therapy, New York, 1904.

TOXEMIA, SEPTICEMIA, AND PYEMIA

By Richard M. Pearce, M. D., and Arthur W. Elting, M. D.

A consideration of toxemia, septicemia, and pyemia is necessarily a discussion of infection and its sequels. An *infection* is the condition produced by the entrance and growth within the body of a pathogenic micro-organism. An infection may be local or general.

Toxemia.—In a local infection, the organisms multiply at the point of invasion and cause, through the toxic substances which they elaborate, local tissue changes; at the same time these soluble substances pass into the general circulation and by their action on various cell groups produce certain constitutional symptoms. This secondary condition is best described by the term *toxemia*. Such is the usual course of events in the majority of acute infectious diseases, as diphtheria, pneumonia, and the pyogenic infections. In some diseases, as tetanus, no demonstrable tissue changes occur at the site of inoculation, all symptoms being due to the intoxication resulting from the absorption of the bacterial products.

Although it is possible that the substances elaborated in the destruction of tissue may cause an intoxication independent of bacterial action, we have little positive evidence that this is the case. It would seem advisable, therefore, to drop the old term *sapremia* in favor of *toxemia*. The term sapremia, first applied to the group of symptoms supposed to be caused by the absorption of the products of decomposition and used almost exclusively in a surgical sense, does not accurately characterize the general group of intoxications due to bacterial products which are now, to a great extent, of medical rather than surgical interest.

Bacterial intoxication, however, may occur in the absence of infection, for example, in the various forms of food-poisoning. Under these circumstances the symptoms due to a poison introduced in large amount into the gastro-intestinal canal depend only upon the rapidity and amount of absorption; infection does not occur, for the organism which produced the toxic substance, even if present, does not invade the tissues. It is essential, therefore, in considering bacterial intoxications to distinguish between those following infection and preceded by a period of incubation and those due to the absorption of preformed toxins without infection. The latter are limited practically to the group of food-poisonings and do not come within the scope of this discussion.

Septicemia.—The older conception of septicemia as a surgical affection due to the invasion of the blood by the organisms of suppuration has delayed the acceptance of the term in its broader meaning. The

general invasion of the blood and tissues by any of the pathogenic bacteria constitute a septicemia irrespective of whether the general infection follows local suppuration, some other disease, as gonorrhea or pneumonia, or develops without evident portal of entry. The application of the term *bacteriemia* to this condition is an attempt to avoid the older terminology. The constitutional symptoms of septicemia are naturally those of toxemia and due to the same factor, the poisons elaborated by the infecting organisms. There is, however, this difference—in toxemia the poison is found in the wound and absorbed therefrom, while in septicemia it is being constantly found in all parts of the body. In the former, the symptoms usually disappear with the removal of the local infection; while in the latter, such removal, once the process is well established, has little or no effect.

Pyemia.—When, in the course of a general invasion of the blood and tissues by pathogenic micro-organisms, multiple secondary foci of suppuration appear, the condition becomes a pyemia. These secondary foci include abscess, diffuse suppuration, endocarditis, synovitis, and any inflammatory condition of either solid structures or the body cavities directly due to the blood infection. The term pyemia, therefore, is not limited to a condition accompanied only by secondary abscess. For example, a gonococcus septicemia accompanied by an ulcerative endocarditis and suppuration in the joints, due to the same organism as a result of its dissemination in the blood, is, strictly speaking, a pyemia, although abscesses in the ordinary sense may not be present. On the other hand, a pneumococcus septicemia accompanied by pleuritis, pericarditis, and mediastinitis is not a pyemia, for these complications are due to direct extension by continuity or contiguity and not to dissemination through the blood.

While in the majority of pyemias the secondary lesions are due either to the streptococcus or the staphylococcus pyogenes aureus, other forms, as the pneumococcus, the gonococcus, and the colon and typhoid bacilli may produce suppuration. The distribution of the infecting organism is frequently accomplished by fragments of thrombi, which, becoming separated from the local lesions, pass as emboli to various parts of the body, and if conditions are favorable cause suppuration wherever they lodge.

Boldt suggests for septicemia the term "acute bacteriemia," and for pyemia, "chronic bacteriemia"; but, both clinically and pathologically, this nomenclature appears to be of doubtful value.

The prognosis, in toxemia, depends on the type of infection, the severity of the intoxication, and the resistance of the individual. In surgical and obstetric infections the general symptoms usually subside promptly after proper treatment of the local lesion from which the toxic substances are absorbed. Streptococcus toxemia is considered more serious than other forms. The resistance of the individual is an important factor; some persons resisting an intoxication to which old or debilitated subjects succumb. Local lesions which cannot be reached surgically or those accompanied by thrombosis always warrant

a guarded prognosis because of the possibility of the development of septicemia or pyemia. The time which elapses before proper treatment is inaugurated has an important bearing on the result. In some diseases, as pneumonia, typhoid fever, and the extent of the local lesion, it is of serious prognostic import. Rugged individuals, for example, with a moderate pneumonic solidification and pyrexia, may quickly succumb to an overwhelming toxemia.

Septicemia, when absolutely diagnosed, has generally been considered almost hopeless. This has been true especially of streptococcemia occurring either in surgical practice or in such diseases as diphtheria, scarlet fever, and small-pox, in which death is often due to this secondary general infection. The results of the bacteriologic examination of the blood in a great variety of conditions indicate, however, that this view must be modified. Although no generalization concerning prognosis can yet be based upon such examinations, there is very definite evidence that recovery may take place in various forms of bacteriemia. Petruschky reports recovery from general infection with pyogenic cocci, as does also Bertelsmann, Libman, and Hektoen. Jochmann reports a case of gonococcemia which recovered. In typhoid fever the bacilli begin to disappear from the blood shortly before the temperature begins to fall, but reappear with a relapse. Schottmüller believes that the number of bacilli found as determined by plate culture is of prognostic value, inasmuch as there is direct relation between the number of organisms and height of the fever and general severity of the attack.

The surgical forms of pyemia and those accompanied by ulcerative endocarditis, meningitis, and suppurative pylephlebitis or extensive visceral abscesses are almost invariably fatal. The so-called chronic pyemia and the milder acute forms, with suppuration in the joints, subcutaneous tissues, or other localities which may readily be treated surgically, frequently recover.

TREATMENT

The treatment of the conditions here discussed—namely, toxemia, septicemia, and pyemia—should be mainly symptomatic. Whenever local foci of suppuration develop which can be reached, free incision should be practised, and the treatment of these local manifestations is essentially the treatment of abscesses in general. These foci should be incised as early and as freely as possible in order that the local toxins may be speedily eliminated. The treatment of metastatic foci differs in no way from that of any primary focus of infection, no matter in what part of the body it may occur. The local manifestations of the disease having been practically attended to, the main object of the treatment should be, first, to eliminate or neutralize the toxins; and second, to support the strength of the patient.

To attain the first object, various measures have been proposed, most of which experience has shown to be of but little practical value. The serum treatment, which at one time promised so much, and of

which detailed mention will be made later, has proved of but little practical avail. The same may be said of the intravenous injections of various silver salts—of formaldehyd and other more or less powerful antiseptics. Against the use of this class of remedies can always be urged the practical fact that they must be introduced into the system in such diluted form that no directly bactericidal or antitoxic action can be expected. The good results which appear in some instances to have followed their use can more probably be attributed to the action of the water introduced into the circulation along with the medicament. The only active neutralization of the toxins which can be confidently expected must come from the antitoxic substances elaborated by the fluids and tissues of the infected individual. To elaborate these substances requires time, and so it often happens that the question of recovery hinges upon the ability of the physician to keep the patient alive for a sufficiently long time to allow of the development of a resistance to the infection. Of all the remedies proposed, there is probably none which can be compared with normal salt solution introduced either subcutaneously, intravenously, or by Murphy's method of proctoclysis. In this way a rapid elimination of the toxins is effected, as has been experimentally demonstrated, and the heart action is supported as it can be in no other way. As much as 1000 ccm. should be infused beneath the breast, under the skin of the abdomen or of the thighs, two, three, or more times daily.

Other valuable adjuncts in the treatment are the various stimulants, especially whisky or brandy. Strychnin is also often of use. Digitalis, when the heart muscle shows signs of weakness, should also be administered hypodermically, preferably in the form of the fluidextract. Cold baths or sponges at frequent intervals when the temperature is above 102.5° F., with an ice-bag constantly to the head, are always of value. Large quantities of fluid should be taken, by mouth if possible, and as much nourishment should be administered as the patient can be induced to retain. The importance of adequate nourishment cannot be too strongly emphasized, and the most easily assimilated fluid foods should be preferred and should be administered at frequent intervals. Fresh air is another most important factor in the treatment of these cases, and a factor which is frequently overlooked. Whenever possible the patient should be taken into the open air in bed and kept there as many hours of the day as practicable, and should sleep in the open air. The treatment of the individual symptoms, such as nausea, vomiting, diarrhea, pain, insomnia, etc., should be purely symptomatic and need not be discussed here.

Under such a mode of treatment it is not at all unusual for cases of septicemia or pyemia to recover, although the battle may be a long and tedious one. The longer the patient lives, however, the better the prognosis, as a rule, becomes, and the more nature tends to come to the physician's assistance.

Serum Therapy.—The progress already made in the treatment of acute infections by immune sera offers some support for the hope that

eventually each form of toxemia or of septicemia may be treated by a specific antitoxic or bactericidal serum. At present, however, successful serum treatment is practically limited to diphtheria. This is due in part to the difference in the chemistry of the bacteria and the manner in which toxins are secreted, and in part to differences in the mechanism of infection. The immune sera in the present state of our knowledge may be divided into (*a*) the antitoxic sera, (*b*) the bactericidal sera, and (*c*) those which are neither antitoxic nor bactericidal, or but slightly so, but which aid apparently by assisting the protective mechanism of the body.[1] To the first group belong the antidiphtheria and antitetanus sera, each of which contain a true antitoxin for the soluble toxin of the diphtheria and tetanus bacillus respectively. The neutralization of the toxin by the antitoxin in each of these sera is apparently chemical in character and analogous to the neutralization of an acid by a base. Unfortunately for the success of the general treatment of toxemia by antitoxic sera, the diphtheria and tetanus bacilli are the only important pathogenic organisms which produce soluble toxins; the toxins of other bacteria are closely bound to the mycoprotein and not readily separated from the cell. The direct antitoxic action of diphtheria and of tetanus serum is well known experimentally and that of the diphtheria serum clinically. Unfortunately, the clinical use of tetanus serum is unsatisfactory, owing to the peculiarity which the tetanus toxin has of uniting with the cells of the central nervous system. This union occurs early in the disease, is a very intimate one, and the poison when so bound to the cell is not at all or but slightly effected by the antitoxin. Technically expressed, these nerve-cells possess receptors for which the toxin has a special affinity, an affinity so great that the antitoxin cannot overcome it. For this reason tetanus antitoxin gives the best results when it is used early in the disease before the toxins are fixed, or, when intradural injection, which allows a less diluted antitoxin to come in intimate contact with the toxin-saturated cells, is practised. The antitoxic sera have little or no bactericidal power.

The bactericidal immune sera are produced by immunization with those bacteria (typhoid, dysentery, cholera, etc.) which are usually described as possessing intracellular toxins in contradistinction to the soluble toxins of the diphtheria and tetanus bacilli. Such sera are not antitoxic or but slightly so. Their antibactericidal power can readily be demonstrated experimentally, but when applied clinically, so great an amount of serum must be employed that its use is impracticable. Moreover, owing to differences or irregularities in complement activity, the mechanism of bacteriolysis in man is not analogous to that in carefully planned experiments. When these problems are solved, rational treatment of bacteriemia may be expected.

The third group, but recently separated, includes the streptococcus, and possibly the staphylococcus and pneumococcus sera. These have no bactericidal power and are but slightly or not at all antitoxic. They act apparently either by stipulating certain cells (phagocytes) or by so

[1] For a critical review of the principles of serum therapy consult Hektoen, vol. i, p. 242.

altering the infecting organisms that they may readily be destroyed by these cells.

As all methods of serum treatment are discussed elsewhere in this work,[1] special mention will be made only of those directed against the staphylococcus and streptococcus.

Antistaphylococcic sera may be dismissed with but brief comment. No serum satisfactory for clinical use has yet been prepared. Experimentally, a serum of but very slight protective power has been obtained. As a rule, even in large doses it will not protect against more than twice the fatal dose, and quickly loses its protective power. It has been estimated that in combating human infection the average adult would require from 400 to 700 cc. of the serum.

Owing to the high fatality caused by the streptococcus and the frequency with which infection, either primary or secondary, occurs, much attention has been given to the preparation and mode of action of antistreptococcic sera. The first serum was announced by Marmorek[2] in 1895, but as yet the exact mode of action has not been demonstrated. This is due to a variety of conditions. We do not know whether we are dealing with one or with a variety of forms of streptococci; little is known of the streptococcus toxin; and until recently the mechanism of the toxic action and of the method by which the body resists this action have been little understood. Furthermore, in the clinical use of the serum the differentiation is seldom made between toxemia and bacteriemia, a point naturally of great importance in the interpretation of results. Besredka,[3] in a critical review, considers the question of the unity or plurality of species of streptococci; and he discusses the various attempts at classification according to morphology, origin, behavior in filtrates of other streptococci, hemolytic, agglutinative, preventive, and fixing power. From this review it would appear justifiable to conclude that no decisive method exists by which the relationship existing between streptococci may be determined.

Little is known of the streptococcus toxin. Simon,[4] who has investigated this subject thoroughly, concludes that, outside of the living body at least, a soluble toxin is not formed and only a weak and uncertain intracellular toxin.

Recently some light has been thrown on the mechanism of the protective action of antistreptococcic sera. The investigations of Bordet, Besredka, Ruediger,[5] and others show that the leukocytes play an important rôle in combating streptococcus infections. These cells in the normal rabbit take up only non-virulent cocci; but in the rabbit receiving the antiserum they engulf virulent cocci also, and if the dose is not too large, the animal recovers. In test-tube experiments the same phenomena are observed. It would appear at first glance that the antiserum stimulates the phagocytes. Further experiments, however, by

[1] Consult Hektoen, Vol. I, page 242, and the different specific infections in this volume.
[2] Marmorek, Annales de l'Institut Pasteur, 1895, ix, 593.
[3] Besredka, Bull. de l'Institut Pasteur, 1904, ii, 16 and 17.
[4] Simon, Centralb. f. Bakt., Orig., 1904, xxxv, 308, 440.
[5] Ruediger, Jour. Am. Med. Assoc., 1905, xliv, 198 (with review of the literature).

Neufeld and Rimpau [1] indicate that there is not a stimulation of the phagocytes, but that some substance in the bacterial cell is neutralized by the antiserum, and after such neutralization the cocci do not resist ingestion by the leukocytes. The substance destroyed by the serum, presumably a toxin, they suppose to be the agent naturally protective against phagocytosis.

That such an explanation of this mechanism is, in all probability, the proper one is indicated by the studies of Wright and Douglas recently confirmed by Hektoen and Ruediger.[2] These investigations, briefly summarized, show that the influence of the body fluids upon phagocytosis is not due to stimulation of the phagocytes directly, but that certain substances (opsonins) in the fluids become attached to the bacteria, which, for some unknown reason, then becomes susceptible to phagocytosis. The opsonins are thermolabile bodies of a constitution analogous to that of toxins and complements, in that they seem to have two groups—haptophore and opsoniferous. (See the chapter on Serum Therapy, by Hektoen, Vol. I, page 242.)

Therapeutically, the use of antistreptococcic sera gives very contradictory results. Some of the most interesting results have been obtained in the treatment of scarlet fever. Baginsky,[3] who believes that the streptococcus has an etiologic relation to scarlet fever, used Aronson's serum on a series of 63 cases of scarlet fever; the doses varied up to 20 cc. The cases treated were severe and he found the serum to have a beneficial action. A close analysis of his figures shows a death-rate in injected cases of 11 per cent. and in uninjected cases of 17 per cent. The death-rate in the hospital for ten years had varied from 12 to 24 per cent. Aronson's serum is prepared by injecting horses with cultures rendered virulent by passage through animals. Moser,[4] who holds that Aronson's method impaired the protective power of the serum against streptococci virulent for man, prepared a serum by injecting horses with cultures freshly obtained, usually from the heart's blood, of fatal cases of scarlet fever. As he has obtained nearly thirty different strains of the streptococcus, and injects them all, his serum is polyvalent. Escherich uses this serum in all severe cases received at the Anna Kinderspital (Vienna). From November, 1900, to July, 1904, 1069 cases of scarlet fever were admitted, and of these, 228 received serum. The mortality in the hospital prior to the serum treatment averaged 14.5 per cent.; since, 8 per cent.; for the same period of time the general mortality from scarlet fever in other Vienna hospitals averaged 13.1 per cent. The dose employed varied up to 180 cc.; a second injection was rarely necessary. The effect of the serum on the clinical symptoms is noticed in a few hours; all symptoms are relieved without shock or collapse; the temperature falls to normal; the pulse and respiration improve and the nervous symptoms subside. For this effect, however, the serum

[1] Neufeld and Rimpau, Deutsch. med. Wochenschr., 1904, xxx, 1458.
[2] Hektoen and Ruediger, Jour. of Infectious Diseases, 1905, ii, 128.
[3] Baginsky, Berl. klin. Woch., 1902, iii, 52.
[4] Moser, Wiener klin. Woch., 1902, xv, 1053; Escherich, Ibid., 1903, xvi, 663; Shaw, Medical News, 1904, lxxv, 817.

must be given early, certainly before the height of the disease. No ill effects of the serum are noted, except in the serum exanthem, which, however, never becomes a serious complication. With the same serum Bokay [1] obtained similar results in a smaller number of cases.

The results obtained in the treatment of rheumatism, puerperal sepsis, and various forms of secondary infection are contradictory.

The important points in treatment by antistreptococcus serum appear to be the following:

(1) It must be demonstrated that the streptococcus is the organism responsible for the condition, or, if present with other bacteria, is the predominating pathogen.

(2) The serum must be used early in the course of the disease; if general extension has taken place, little or no beneficial result may be expected.

(3) The first dose should be at least 20 to 30 cc., and if this does not produce a perceptible change in symptoms, it should be repeated in twelve hours. If no relief follows such treatment, it is useless to continue that particular serum and another brand should be tried. Injections should be made, if necessary, every twenty-four hours.

(4) The polyvalent sera appear to give more favorable results than those prepared with a single strain of streptococcus.

The vaccine (bacterin) treatment of these pyogenic infections is discussed by Hektoen, Vol. I, page 242.

[1] Bokay, Deutsch. med. Wochenschr., 1904, xxx, 6.

SYPHILIS

By J. William White, M. D., and Alfred C. Wood, M. D.

Syphilis is a chronic, specific, contagious disease, communicated from one individual to another either by direct contact with the lesions of the disease, or with their secretions containing the specific organism, and by heredity.

Two distinct types are thus recognized—the *acquired* and the *hereditary*. The former will be considered first.

The acquired form is characterized by an *initial lesion*, an interval during which there are no new manifestations, a period of *secondary symptoms*, followed either by permanent cure, or by a latent interval and subsequent *tertiary* developments.

The clinical course of the disease is, for convenience, divided into periods, as follows:

(1) Period of *primary incubation*, or that intervening between the exposure to contagion and the appearance of the chancre.

(2) Period of *primary symptoms* (chancre and adenitis).

(3) Period of *secondary incubation*, or that between the appearance of the chancre and the development of secondary symptoms.

(4) Period of *secondary symptoms*—syphilides of the skin and mucous membranes (roseola, papules, pustules, mucous patches, etc.). This period lasts from one to three years.

(5) *Intermediate period*, during which there may be no symptoms; or irregular, slight, and less symmetric and less generalized manifestations may be present. This period is variable, lasting two to four years, and ending in complete recovery, or in

(6) Period of *tertiary symptoms* (tuberculo-ulcerous syphilides, periostitis, osteitis, gummata, lesions of the nervous system, etc.). The duration of this period is unlimited.

Although the *first stage* of syphilis begins at the time of infection, the *first symptom* is the initial lesion. The period between the contamination and the appearance of the initial lesion or chancre varies between ten and fifty days, the usual time being *about three weeks*. After the development of the chancre the period of *secondary incubation* begins, and continues until the secondary symptoms appear. This interval is usually *about six weeks*, but may, in rare instances, be prolonged to *eight or even ten weeks*.

As already stated, syphilis is transmitted from person to person by direct contact with certain of its lesions or with the secretions from them, containing the specific germ of the disease. It is not definitely

known whether infection would follow such contact if the skin or mucous membrane was perfectly sound, but the belief prevails that infection usually takes place through an abrasion or area from which the epithelium, from some cause, has been lost. It is thought that normal unbroken skin constitutes an effective barrier, while the mucous membrane has a much more feeble resistance. Whether the virus enters the system through an abrasion or through the normal membrane, a lesion will develop at the point at which the infection took place. This is called the *initial lesion*, or *true*, *hard*, or *Hunterian chancre*.

The Chancre.—The early manifestations of a chancre present nothing definite. They may be merely a small hard papule, a previously existing wound that fails to heal, or an abrasion that occurred at the time of suspected infection. As a rule, these indefinite abrasions gradually enlarge and become rounded, raised, and well circumscribed. By the end of the third week after infection the base of the lesion will, in most cases, be found densely indurated, giving a very hard and resisting sensation when grasped between the thumb and finger. This induration, when typical, constitutes the distinguishing feature of a true chancre. In addition, the lesion gives little if any pain. In most cases the epidermis is exfoliated, leaving an erosion from which there is but little secretion. There are many factors, however, which modify the course of the chancre. For example, pyogenic infection may have been added to the syphilitic virus, or the sore may have been altered in its characteristics either by uncleanliness and neglect, or by caustics or other irritating—and usually inappropriate—treatment. There are, however, certain well-marked clinical types of the initial lesion. The simplest division is the following: (*a*) The papule, with but little induration; (*b*) an indurated area, without ulceration; and (*c*) an ulcer surmounting an indurated base. Each of these is subject to great variation both in appearance and in course.

Secondary Symptoms.—The period of *secondary symptoms* varies greatly, being dependent upon the virulence of the infection, the condition or vitality of the patient, and the thoroughness of the treatment. In favorable cases all symptoms may disappear in a few weeks. Sometimes, however, mucous patches in the mouth persist or recur, and certain cutaneous lesions, especially those affecting the palms of the hands, resist treatment for a long time. Irrespective of these symptoms, the secondary period of the disease may be said to cover from one to two or three years. Occasionally manifestations characteristic of the late or tertiary stage of the disease appear within the first year (precocious or malignant syphilis). This indicates either (*a*) an exceptionally large dose of contagious element, (*b*) its unusual virulence, or (*c*) diminished resistant power on the part of the patient. In such cases the treatment appropriate for the tertiary stage must be instituted, the type of the lesions and not the actual time that has elapsed being the therapeutic guide.

With the final disappearance of secondary symptoms, the patient may be cured; or, in other words, may never have any further evidences of the disease. Neglected cases and those that have been inefficiently

treated, after an indefinite latent period are apt to develop, at some time, *tertiary symptoms*. These symptoms may, in exceptional cases, follow an apparently thorough course of treatment.

Syphilis is one of the most chronic of all diseases. The primary and secondary symptoms may disappear in a few weeks or months or may last much longer; the so-called tertiary lesions may develop as late as five, ten, fifteen, and even twenty years subsequently. Even when regular and intelligent treatment has been followed, the person afflicted is not sufficiently free from the disease to marry until four years after the beginning of the attack, and then only if no relapses have occurred in the meantime. Only in exceptional cases will it be wise to give permission to marry at an earlier period.

Pathology.—Spirochæta pallida, demonstrated in syphilitic lesions by Schaudinn and Hoffman in 1905, is now almost universally accepted as the specific cause of syphilis. It certainly seems to be constantly present in the early lesions.

The chief histologic characteristic of syphilis, wherever its manifestations are found, is the small round-celled infiltration. This first develops at the point of inoculation, forming the chancre and causing the induration. From this focus the poison enters the system. The lymph-channels and nodes become enlarged and hard. Although the cause of this condition is somewhat obscure, it is reasonable to suppose that the process is similar to that observed in the blood-vessels. The next step is an infiltration of the walls of the latter, beginning in the intima and adventitia and extending by contiguity. The lumen of the vessels is thus narrowed or even occluded. In the superficial capillary loops this process is manifested by an eruption on the skin and mucous membranes. The kind of lesion—macule, papule, vesicle, pustule, etc.—depends upon the degree and stage of the infiltrating process. The lesions of the later stages of the disease—gummata—resemble tubercle nodules histologically, and are illustrations of an advanced stage of the same process. The pathology is essentially the same in all stages of syphilis, and in both the acquired and inherited forms.

In many cases both the primary and secondary lesions of syphilis will disappear spontaneously; in fact, many of the manifestations show a strong tendency to self-limitation. In a certain proportion of cases, after a variable period, late or tertiary symptoms appear. This may occur to a patient who has followed the prescribed course of treatment, but is infinitely more apt to take place if the individual has not been treated or has been treated improperly. Severe and even serious tertiary lesions may follow the mildest early manifestations. It is, therefore, necessary to treat the so-called "mild" case as thoroughly as the most exaggerated.

Diagnosis.—It will be inferred from what has been said that a diagnosis based on the appearance of the local lesion will frequently be impossible, and, in practice, it is undesirable, in the majority of cases, to make a definite statement or to begin constitutional treatment until other signs of the disease have become manifest (*vide infra*).

The symptoms upon which a positive *diagnosis* of syphilis may be made are: Enlargement of the lymph-nodes, not only of those adjacent to the initial lesion, but also those remotely situated, as the postcervical, epitrochlear, etc.; a general cutaneous eruption, usually characteristic; some indisposition and muscular pains, frequently attributed to rheumatism by the patient; slight fever; and later, probably some falling of the hair and sore throat. These are the so-called secondary symptoms, or the symptoms of the second stage of the disease, and are—the eruption and enlargement of distant glands being present—conclusive evidence of the existence of syphilis. The general distribution of the lesions shows that the disease is constitutional, *i. e.*, that the blood is charged with the specific poison.

These symptoms presuppose a previous chancre or sore situated on the genitals or elsewhere, and even if the lesion has already healed, such a history will usually be obtained. In some cases, however, the chancre, situated in the urethra of the male or within the vagina in the female, will be overlooked, and the secondary symptoms may then be the first intimation of the disease. Usually the initial lesion does not appear until about three weeks after the infection and may not assume any diagnostic features until much later. A further period of about six weeks elapses between the appearance of the chancre and the development of the secondary symptoms. It will thus be seen that, as a rule, specific treatment will not be instituted until about nine weeks after the date of infection. There are circumstances which justify curtailment of this period (p. 467).

If the spirochæta pallida is found in a suspicious lesion, or if a positive Wassermann or Noguchi reaction is obtained, the treatment should be begun at once, without waiting for the slow clinical developments.

TREATMENT

In undertaking the treatment of a case of syphilis, two problems are presented: the first is to prevent the individual from transmitting the disease to others—innocently or otherwise—and the second, to eliminate the poison from the person's system.

The patient should be made to fully understand—(1) that the primary lesion of syphilis (the chancre) is exceedingly contagious; (2) that the secondary lesions of the skin and mucous membranes are quite infectious. The saliva becomes infectious when mucous patches exist in the mouth or throat; (3) that the disease may be conveyed by the blood and lymph in both the primary and secondary stages. (The tertiary lesions are probably not contagious, as a rule.) He should, therefore, be instructed that a genital chancre is a positive bar to coitus, which must not be resumed until permission is granted by the physician. (Any lesion of the genital organs, however slight, should always be considered as demanding rigid continence.) In cleansing the chancre, surgical cotton or gauze should be employed, and destroyed—preferably burned—after use. Bath sponges, towels, etc., that may have come in contact with the chancre should not be used by any

other person until they are thoroughly washed and boiled. The secretions from the chancre, conveyed by these articles or by the underclothing, is capable of causing the disease in another person if coming in contact with a scratch or other abrasion of the skin. A chancre appearing on any other part of the body must be fully protected to prevent accidental transmission to others.

As the lesions of the skin during the second stage of the disease are infectious, the patient should have his own bath towels, etc., which should not be used by anyone else, and these, with his underwear, should be washed separately from the general laundry, and the articles should be well boiled.

The presence of mucous patches in the mouth or throat, however small, renders the saliva infectious; hence these cavities should be inspected frequently, and if they are observed, the patient should refrain from kissing anyone; his table utensils—glasses, cups, etc.—should not be used by anyone else; and any other article coming in contact with his mouth should be considered as being infected and as dangerous for any other person to use. If it is impossible to examine the mouth and throat frequently during the secondary period of the disease, it will be wise to instruct the patient as if his saliva was known to be infectious.

It is a matter of common observation that the main stress of the disease falls on the tissues or organs that are overtaxed physiologically, or are weakened by previous disease or by traumatism. It is of the first importance, therefore, in the beginning to make a careful examination of the individual in order to ascertain if the general health is below par, or if any latent local trouble is present which might be aggravated by the disease. If either exists, steps should be taken at once to correct the condition. During the whole course of treatment the patient's habits should be so regulated as to maintain the highest possible health and vigor. It is especially necessary that he should avoid overtaxing the nervous system. Continued anxiety is probably more harmful than excessive physical exertion.

The most serious consequences of syphilis are the various disorders of the nervous system that occur some years after the date of the infection. The primary and secondary symptoms generally yield well to treatment, and gummatous deposits also disappear, as a rule, under active medication, but up to this time there has been no certain means of preventing serious degenerations of the cerebrospinal system. It may be assumed from this fact that the treatment in a certain portion of the cases has failed to entirely eliminate the poison.

Recent experimental work on this subject appears to show that very early treatment would probably prevent the serious degenerations of the central nervous system which occur as a late manifestation in a certain portion of those who have been infected with syphilis. It is not possible to discuss this phase here, but the interesting suggestion of Wassermann, that the prolonged course of the infection, during which time the production of antibodies in the cerebrospinal system is continuous, causes an

exhaustion or degeneration of the nervous system, with resulting paralyses, etc., is certainly worthy of consideration. The antibodies appear to remain in the spinal fluid for twenty or thirty years, or even longer, after the disease was acquired. If, therefore, the poison could be eliminated before this excessive tax takes place, it is assumed that the nervous manifestations would be prevented.

In all cases of doubt, it is unquestionably our duty to employ one or both of these tests, if at all possible. The Wassermann and Noguchi reactions not only enable us to establish the diagnosis, but they appear to offer a definite means of determining the effectiveness of the treatment. While these methods are new, their value is already firmly established. They may in time be still further simplified, or new processes may be discovered which will permit of universal application by the general practitioner. At any rate, it seems as though the treatment of syphilis in the early stages was approaching a degree of precision that will permit of a more accurate prognosis in the future.

Unfortunately, at the present time these aids will be available only to the few physicians associated with the modern laboratory in the larger cities, so that the average practitioner will still be obliged to depend upon the clinical symptoms as heretofore.

A. Initial Lesion.—The management of a case of syphilis usually begins with the treatment of the chancre, or, to be more exact, with the treatment of the suspected lesion, for in a great many instances, as already stated, a positive diagnosis is impossible until the appearance of the secondary manifestations. These local lesions may, therefore, be considered under three subdivisions, namely: (*a*) Before a diagnosis is possible; (*b*) after the diagnosis of chancre is established, and (*c*) exceptional cases.

Before a Diagnosis is Possible.—The most important consideration for the patient at this time is a correct diagnosis. If possible, scrapings of the lesion should be examined for the spirochætæ, otherwise all of the evidence should be carefully preserved. For this reason, an uncertain lesion should be excised only in exceptional cases, nor should it be subjected to the action of strong caustics. The former would remove an invaluable clue, and the latter would probably so modify the appearances as to render any opinion of questionable value.

In all suspicious cases the possible contagious character of the lesion should be explained, and full directions given to the patient as to the precautions to be employed in order that others may not be exposed to the danger of infection. Personal contact, of course, will be prohibited, and basins, soap, towels, etc., used in cleansing the sore must be used by no one else. When possible, cotton, surgical gauze, or old linen should be used instead of towels, as these may be burned, and thus all danger to others from this source avoided.

The proper treatment of these cases, then, may be expressed in the single word "cleanliness." This implies that the part is to be bathed with some mild antiseptic frequently enough to ensure a clean surface. For this purpose boric acid solution is as useful as any. Bichlorid of

mercury (1 : 2000) is advised by many writers, and may be employed. After thorough cleansing aud drying, a dusting-powder is all that is needed. Among the suitable powders may be mentioned talcum, bismuth subnitrate, starch, oxid of zinc, or some combination of these. Iodoform is now rarely used on account of its penetrating odor, but one of its substitutes may be employed. If there are hyperemia and swelling a carbolized lead-water and laudanum lotion is frequently the best application. A wet dressing of any sort may be applied by laying upon the sore pledgets of absorbent cotton moistened in the lotion. If the lesion is situated on the mucous surface of the prepuce or on the glans subpreputially, the raw surface should in any event be covered with a little absorbent cotton.

With this treatment such minor conditions as herpes, simple abrasions, etc., will speedily heal. Chancroids will declare themselves by the pain, distinct ulceration, and profuse secretion. In the latter case the treatment appropriate to chancroid should be immediately instituted. Chancres will remain more or less stationary, perhaps increasing in size somewhat, but showing little tendency to get distinctly better or worse.

When the Diagnosis of Chancre is Established.—The first question concerns the advisability of excising the lesion.

Syphilis is at first a local affection, but just how long it remains local is not known. By the time the diagnosis is clear, the infection is almost surely constitutional, therefore excision of the primary lesion will not abort the disease. It is possible that continued absorption of poison may thus be prevented, and that the secondary manifestations will be less marked, or they may, in rare instances, fail to appear after the early removal of the initial lesion, but the course of the disease will probably not be otherwise altered, nor will the indications for treatment be modified or shortened.

Excision of chancres may be proper—

(1) If a diagnosis is possible within the first few days, especially when confirmed by the demonstration of spirochætæ or by confrontation, the sore may be excised, provided it is so situated that no mutilation of parts, interference with function, or surgical complication will result. The wound may be united by sutures in these cases.

(2) In any case in which a chancre is situated on the prepuce or on the skin, so that it may be removed without any mutilation, excision should be practised.

Excision should not be performed—

(1) If loss of function or deformity would result, or if the situation is such that there might be difficulty in controlling the hemorrhage.

(2) If the lesion is of doubtful character.

It should be understood that (*a*) excision of a chancre in the earliest stages will but rarely abort the disease; (*b*) at a later period, at best, the manifestations may be rendered less severe, and (*c*) in both cases the usual constitutional treatment should be carried out.

If the lesion is not removed, the same treatment should be continued as was advised before the diagnosis was made. Even when the local

lesion is perfectly characteristic, constitutional treatment should not be begun, unless some imperative necessity exists, until glandular enlargements or cutaneous eruptions appear, unless the character of the disease is otherwise positively established.

Exceptional Cases.—There are certain important conditions that may be met with which would require a modification of the above treatment. These are:

(1) Chancres that show a tendency to become phagedenic or gangrenous. These are probably infected with pyogenic micro-organisms. In such cases very frequent and very thorough cleansing with antiseptics and hydrogen peroxid is essential. No external application will avail if undermined or covered areas of infection are not cleaned at frequent intervals and kept drained. In this way burrowing will usually be prevented or arrested and a healthy condition established. In the most aggravated cases it may become necessary to cauterize the lesion thoroughly with fuming nitric acid, or to excise the affected area and then cauterize to arrest the continued tendency to spread. But this necessity will be very exceptional if the above treatment is properly carried out. When a healthy state of the sore has been established, the treatment already described should be adopted.

(2) Either of the following conditions may demand immediate constitutional treatment by mercury, without waiting for the appearance of secondary symptoms: (*a*) When a chancre appears on a finger or hand of a physician, obliging him to give up work until it has healed; or affects the lip or other conspicuous part of a person who may not be able to seclude himself, or in whom it is especially necessary to conceal the nature of the trouble. (*b*) When the person affected is married, and it is desired to destroy all evidence of the disease at the earliest possible moment. (*c*) When a pregnant woman acquires a typical chancre. (*d*) Immediate treatment may be begun if the sore is distinctly Hunterian in type, and if the diagnosis is verified by other means.

There may be other instances in which immediate treatment—*i. e.*, before a positive diagnosis is made—must be begun, but the physician must ever bear in mind the disadvantages of such a course, and yield only when absolutely necessary.

The syphilitic adenopathy, whether inguinal, postcervical, epitrochlear, or more general, calls for no local treatment and disappears largely as the initial lesion heals, and the eruption fades after the beginning of constitutional treatment. Some evidence of it, in the shape of slightly enlarged, moderately indurated lymph-nodes, may remain indefinitely.

Constitutional Treatment

B. Secondary Stage.—The diagnosis of syphilis having been established by the chancre, the general glandular enlargement, the skin eruption, etc., or by finding the specific germ, or by obtaining a definite serum reaction, constitutional or "specific" treatment should be begun without further delay. With almost perfect unanimity authorities agree that

mercury is the one remedy for syphilis in its earlier stages. The effect of mercury, when properly administered, upon syphilitic lesions, especially the primary and secondary manifestations, is truly remarkable, and well deserves the designation "specific." We have no positive knowledge of the considerations that led to the use of this drug in syphilis, and as there are no facts known to-day that explain the effects so uniformly observed it is reasonable to suppose that some chance observation—such as a rapid cure of syphilitic manifestations in persons who worked in mercury—may have been the origin of the present universal treatment.

The antiquity of syphilis has been well established by a number of writers, and Dabry quotes Chinese manuscripts to show that syphilis was treated by mercury nearly 5000 years ago.

Mode of Administration.—Mercury has been administered in a variety of ways, chief among which are:

(1) By the mouth.

(2) By endermic administration (inunctions, baths, fumigations, etc.).

(3) By hypodermic administration.

Irrespective of the drug given and the manner in which it is administered, various therapeutic systems or plans of administration have been employed by syphilographers. These are: (1) The expectant or symptomatic treatment; (2) interrupted or intermittent treatment; and (3) continuous treatment.

The **expectant treatment** is based on the assumption that syphilis is a self-limited disease, and that treatment is, therefore, only required during the presence of active symptoms. As soon as the manifestations disappear, treatment is suspended, to be resumed again if any symptoms return. This theory is founded upon fallacious reasoning. That syphilis is not a self-limited disease must be clear to all who have studied the subject. While certain of the lesions may disappear without treatment, and while there may not always be a return, tertiary lesions are so common as to compel recognition. The expectant treatment is little better than no treatment and is to be condemned.

The Interrupted, Intermittent, or Modified Expectant Treatment.—This was introduced by Fournier, who believed that prolonged treatment of syphilis was more efficient than a short, though vigorous course of medication. On the other hand, he held that after a certain time, if continuously administered, mercury loses all therapeutic value; hence his belief in the necessity of intermitting the treatment from time to time. By this method the mercury is administered for two months in suitable doses, then omitted for one month, and then renewed for six or eight weeks, when another intermission of three months is prescribed; it is then given again for six or eight weeks and omitted for several months, and this alternation is continued for three or four years. This method we believe is not applicable to a disease characterized by such prolonged and obstinately recurrent pathologic processes as is

syphilis, which should certainly be met with a more persistent and uninterrupted treatment.

The **continuous** or **uninterrupted** treatment is certainly the method of choice in the average case. The tenacity of the syphilitic infection demands persistent treatment if it is to be promptly and fully eliminated. It is not meant, of course, that a particular drug must be given in a certain dose so many times every day for a definite length of time. It may be necessary to discontinue any drug for a few days or even weeks; or the drug as well as the form of administration may have to be changed several times in a given case, and the dose adjusted to the requirements of the individual. Although the mercurial may have to be stopped temporarily for some of the reasons given above, the principle of continuing its use as steadily as possible during the active period of the disease should not be lost sight of.

1. **By the Mouth.**—The vast majority of syphilitic patients are treated by the administration of mercury by the mouth. This custom has undoubtedly become popular on account of the ease of administration and opportunity to carry out the treatment without attracting any attention.

Of the various preparations of mercury suitable for ingestion by the mouth, the protiodid is, perhaps, the most popular. The dose is from $\frac{1}{3}$ to $\frac{1}{2}$ gr. three or four times a day, given according to the rules stated later (p. 470).

The bichlorid, $\frac{1}{24}$ to $\frac{1}{12}$ gr.; biniodid, $\frac{1}{16}$ to $\frac{1}{8}$ gr.; tannate, $\frac{1}{2}$ gr.; gallate, $\frac{1}{2}$ gr.; blue pill, 1 to 2 gr.; mercury and chalk, 1 gr., etc., may be employed.

In order to describe such a course of treatment, let us assume a typical case, one in which the primary lesion has been followed by the appearance of secondary symptoms. In doing so it is to be understood that there are no hard-and-fast rules which are uniformly to be followed, but that the treatment must be carefully adapted to the individual as well as to the particular type of his disease.

In beginning the treatment of a case of syphilis, the patient should be informed not only of the length of time necessary to effect a cure, but also as to the details concerning his habits, which have a bearing on the progress of the case. The patient's general health needs constant supervision, inasmuch as the mercurial preparations do not act so well if the vitality is reduced. The weight is an important factor in estimating the success of the treatment. In a general way, it may be stated that if the weight is increasing he is probably doing well, whereas if it is declining it is nearly certain that the case is not progressing satisfactorily. It may be necessary to administer iron if the patient is anemic, and bitter tonics are indicated if the appetite is deficient.

Inasmuch as a foul condition of the mouth or diseased teeth increase the liability to salivation when the patient is taking mercury, he should be sent to a dentist to have his teeth put in good condition, otherwise the dose of the drug may have to be reduced below the proper therapeutic point. The teeth should then be kept clean by the use of a soft

tooth-brush and a plain chalk tooth-powder after each meal. Mild antiseptic, non-toxic mouth-washes should be used several times in twenty-four hours. Tobacco chewing should be prohibited and smoking permitted in moderation only, on account of the irritating effects of these habits on the buccal and pharyngeal membranes.

The regular treatment of a case of syphilis in the beginning of the secondary stage should begin as soon as the diagnosis is made. Protiodid of mercury may be prescribed as follows:

℞. Hydrargyri protiodidi .....gr. xx 1|3
Confectionis rosæ.....ʒj 4|0.—M.
Ft. pil. No. lx.—Sig.

Take one pill after each meal for two days; on the third and fourth days, one pill after breakfast, one after lunch, and two after dinner; on the fifth and sixth days, two pills after breakfast, one after lunch, and two after dinner; on the seventh and eighth days, two pills after each meal, and so on, increasing the dose by one pill every second day until slight symptoms of ptyalism (see p. 479) are observed. As soon as the earlier signs of ptyalism appear, the dose must be reduced or discontinued until the mouth conditions become normal, and then resumed in from one-half to two-thirds the dose the patient was taking when salivation occurred. The rule is to administer the largest amount possible, short of producing the toxic effects of the drug. The tolerance of the patient and the effect upon the disease will, therefore, be the guides. For example, if salivation appeared when the patient was taking 6 pills daily, the dose would be reduced to 4 or perhaps 3, and continued at this amount. (See footnote, p. 472.)

It is necessary, therefore, to see the patient frequently during the period when the ascending doses are being taken, and to caution him to report promptly when any of the earlier effects of the drug show themselves. Sometimes it is desirable to combine a tonic with the mercurial. If a simple bitter is indicated, the following may be given:

℞. Hydrargyri protiodidi.....gr. xx 1|3
Extracti gentianæ vel quassiæ.....ʒij 8|0.—M.
Ft. pil. No. lx.—Sig.

Take as directed in the last prescription.

More active tonics, such as quinin, arsenic, and iron, may also be combined, but it will be found better, as a rule, to give such active remedies separately, so that the dose of the mercury may be modified without interfering with that of the tonics.

In some cases the protiodid causes abdominal cramps and diarrhea before the full dose is reached, or during the regular administration of the reduced dose. In such cases green vegetables, fruit, and all articles of diet that have a laxative effect should be omitted. After the diet has been properly corrected, if the cramps are mild and infrequent, a little paregoric (20 to 30 drops) may be taken as needed. If, on the other

hand, the abdominal pains persist, it will be better to substitute some other preparation of mercury. Mercury and chalk in 1-gr. doses or the tannate or gallate in ½-gr. doses, may be given in the same manner as directed for the protiodid. Having determined upon the preparation for administration, and found the proper dose in the manner described, the remedy may be taken for three weeks, then discontinued, and inunctions used for a week or ten days, the two methods being alternated in this way. The more severe, obstinate, or precocious the symptoms, the greater the necessity for the use of inunctions. In mild cases, which do perfectly well under the administration by the mouth, the inunctions may be omitted if the patient is so situated that the latter cannot be carried out without the fact being known to others.

If the patient is taking one of the above-mentioned preparations and following the other directions, the syphilitic lesions should promptly begin to undergo resolution and gradually disappear. If any of the manifestations remain at a standstill, the dose of mercury is too small or the preparation ineffectual. In either case the fault should be promptly corrected. If the treatment is properly adjusted to the case, the chancre will rapidly cicatrize, the skin eruptions disappear, the glandular enlargements diminish, and the alopecia, if present, will be arrested. When all goes well, this treatment is to be continued for eighteen months to two years. It may be necessary during this time to omit the remedies occasionally for a week or two at a time, to change the dose, or the particular preparation, or the method of administration, but all this must be the subject of constant and intelligent supervision. If the lesions do not disappear properly, or if they recur, the case is not progressing satisfactorily.

One of the most persistent and annoying complications of the secondary stage is ulceration of the mucous membranes of the mouth or "mucous patches." These affect chiefly the tonsils, but may appear on the tongue or any part of the buccal surface. Their presence is an indication for stricter mouth hygiene and for local applications. Of these, silver nitrate, 20 to 40 gr. to the ounce of distilled water, is the most efficient. It must be borne in mind that the saliva is infectious as long as the mouth lesions persist.

In some instances the so-called "tertiary" or "late" lesions appear during the secondary period. This constitutes the "precocious" type of syphilis, and calls for the addition of potassium iodid or some other form of iodid in addition to the mercury, irrespective of the time that has elapsed since the infection. These tertiary manifestations are: Gummata of the skin or mucous membranes, periosteal nodes, osseous or articular lesions, epididymitis or orchitis, enlargement of the liver or spleen, affections of the eye or ear, or any of the numerous forms of syphilis of the nervous system.

As already stated, in the cases that do well, the lesions rapidly disappear, and in many instances permanently. In a certain proportion of patients some recurrences are observed. The treatment must be continued for the full period of two to two and a half years in the former

class. For the latter, the period of active mercurial treatment should be continued for at least one year from the date of the last symptom.[1]

A few syphilographers are opposed to the ingestion method of treating syphilis, claiming that the proportion of the drug absorbed is always uncertain; that it places the treatment entirely in the hands of the patient, who is prone to neglect it when all symptoms have disappeared; that derangement of the gastro-intestinal tract is sometimes caused by the drug; and lastly, that it is not so effective as other methods of administration.

The authors do not share the opinions expressed in these objections. It will be admitted, however, that exceptional cases may do better under some other form of administration, and it is usually desirable to alternate this method with inunctions. The objections stated may be largely overcome through intelligent supervision of the case.

Nucleid of Mercury.—Hollen believes mercury nucleid to be the most effective preparation of mercury in the treatment of syphilis. It contains 10 per cent. of metal, is a brownish-white powder, and is soluble in warm water.

It may be administered in chocolate-coated tablets, containing $\frac{1}{4}$ gr. each. Hallen makes the following claims for this preparation: It does not disturb the digestion or assimilation; it combines the specific action of the base and the antiseptic action of nucleinic acid; it increases the bacterial power of the blood by the multiplication of polynuclear and mononuclear leukocytes, and acts in harmony with the metabolic processes.

2. **Endermic Administration.**—*Inunction* is the term applied to the exhibition of mercury by rubbing the ointment into the surface of the body. Different compounds have been recommended from time to time, but the blue ointment (unguentum hydrargyri) is employed almost exclusively. The oleate of mercury sometimes advised is more irritating to the skin than the blue ointment, and is apparently less active therapeutically.

The inunction of blue ointment is one of the most effective ways of administering mercury in the second stage of syphilis. It is the important part of the treatment at the various hot springs that have acquired a special reputation in the treatment of this disease. In order to secure the best results, certain details must be carried out. The general nutrition and tone of the patient must be maintained at a high standard, as in the administration of mercury in any form. This is

[1] While this represents what we believe has been the best practice up to this time, the treatment may be modified any day by new discoveries (see Dioxydiamidoarsenobenzol, or "606," p. 481).

In view of the fact that in the Wassermann and Noguchi reactions we have a means of determining when the syphilitic poison has been eliminated, one of these tests should be adopted whenever possible as a means of ascertaining the effectiveness of the treatment and of deciding when medication may probably be abandoned. This holds good for any stage of the disease and for all of the various methods of treatment. After patients have been dismissed as cured, it is very important to subject them to one of the above tests at intervals of six months or a year at first and less frequently as time goes on. In this way the tertiary lesions could be anticipated and treatment undertaken at a favorable time before any structural changes take place.

accomplished by proper food, fresh air, suitable exercise, and tonics, if indicated. The patient is directed to use the same suit of underwear for a week, when a hot bath may be taken and fresh underwear put on. The inunction may be taken at such time a day as is most convenient. This will usually be at bedtime, except in the case of persons who give up their whole time to the treatment.

The ointment should be fresh, as old preparations are apt to be more irritating to the skin. In cold weather, or when the ointment is unduly stiff, or when the skin is especially delicate, or to facilitate the rubbing, it may be mixed with an equal portion of vaselin or lanolin. It is desirable to have the druggist dispense the preparation, accurately weighed, in waxed paper or capsules, so that the dose may be properly regulated. It is both undesirable and unsafe to guess at the amount used. For an adult, from 30 to 60 gr. of the official blue ointment may be rubbed into the skin once a day. The smaller dose will usually be sufficient, but it may be increased to 40 gr. in some cases. Rarely will more be required.

When circumstances will permit, the ointment should be applied by a nurse, or "rubber," but if this is impossible, the patient may carry out the treatment himself. Gold rings should be removed from the hand engaged in the rubbing, as the mercury will form a coating on gold. The non-hairy portions of the body are selected for the application, as the salve and the friction are almost certain to cause a dermatitis or folliculitis on the hairy surfaces. Further, if applied to the same part repeatedly an irritation of the skin will result. Therefore the ointment should be rubbed in different parts successively. The routine may be as follows:

First day, right arm and forearm; second day, left arm and forearm; third day, right side of chest and axilla; fourth day, left side of chest and axilla; fifth day, right flank and loin; sixth day, left flank and loin; seventh day, right groin, thigh, and leg; eighth day, left groin, thigh, and leg; then repeating in the same order, always avoiding such portions of these regions as contain much hair. The ointment should be applied by a combination of friction and massage, from twenty to thirty minutes being consumed in the treatment. The manipulations must be gentle, to diminish as much as possible the tendency to irritation of the skin. When the rubbing is done by a nurse, it is sometimes recommended that rubber gloves be worn to prevent salivation; although such a result is possible if the bare hands be employed, it is of very rare occurrence. Of course, no such precaution need be taken if the patient applies the ointment himself.

During this treatment the patient must be carefully watched, and the inunctions discontinued at the first signs of tenderness of the gums. (See p. 479.) After these have all disappeared, the course is repeated again, using a slightly smaller dose. This may be kept up, with appropriate intermissions, for the entire treatment of the secondary period; but it will be found less irksome to the patient if the inunctions and the internal administration be alternated. In the severer types of the disease

the former should predominate. For milder cases the periods of the mouth ingestion may exceed the inunctions about as 3 to 1.

Gastro-intestinal disturbances may occur during the use of inunctions, although much less frequently than during the internal administration of mercury.

The Royal Army Medical Corps method is as follows:

The first course consists of 40 gr. of mercurial ointment, rubbed in daily, for forty-two days.

Three months' interval.

Second course, forty-two daily inunctions.

Interval of three months.

Third course, thirty daily inunctions.

Interval of six months.

Fourth course, thirty daily inunctions.

Interval of six months.

Fifth course, twenty daily inunctions.

The **treatment of syphilis at Aix-La-Chapelle,** perhaps the most noted of the thermal springs, may be of interest: Between 7 and 8 o'clock in the morning the patient takes two or three glasses of sulphur water, with or without the addition of salts, prepared in the factory of the Aix-La-Chapelle natural spring products. Strong patients immediately take their bath, those suffering from affections of the central nervous system or who are otherwise debilitated take a light breakfast and delay their bath until two hours later. The temperature of the bath averages 95° to 98° F.; but those with degeneration of the arteries are not allowed to take baths warmer than 92° to 94° F. The duration of the bath varies from five to twenty minutes, according to the strength of the patient. After the bath the patient rests for twenty or thirty minutes, care being taken that he does not perspire too freely in the interim. Inunction of mercurial ointment is employed after breakfast or after the bath. The process is carried out as follows: With the naked hands an experienced masseur rubs 75 gr. of 33 per cent. blue ointment evenly on the skin for a period of twenty minutes (hairy patients are previously shaved to avoid folliculitis). Selecting different parts of the body from day to day as above described.

A second treatment of four or five weeks is advised from six months to a year after the termination of the first, and a third after another six or twelve months' interval. If no symptoms appear, the fourth course is given twelve months after the last, and earlier if a relapse occurs. The fifth and last course is given at the end of another year.

For tertiary lesions potassium iodid or sodium iodid is given internally in addition to the inunctions.

The success attained at some of the thermal springs in the treatment of syphilis may be duplicated at home in most instances, provided the patient will give up his time to the case and follow a similarly strict regimen.

Fumigation or the **mercurial vapor bath** has been employed in the treatment of syphilis. It may be carried out as follows: The

patient is stripped, seated upon a plain wooden chair, and surrounded loosely with blankets, which are secured closely at the neck. By means of a suitable lamp, 20 gr. of calomel, or double this amount of cinnabar, should be vaporized under the blankets, steam being generated at the same time. The bath may be continued from fifteen to thirty minutes, according to the requirements of the case. It is desirable to give the baths at bedtime when possible, and to have the patient retire at once, wrapped in the blanket used in the bath. The baths may be repeated every day or second day, according to the urgency of the symptoms and the toleration of the patient.

The vapor bath may be used in the treatment of any case of syphilis when the symptoms do not respond to the administration of the drug by the mouth or when inunction or hypodermic injections cannot be carried out for any reason. It is also useful for its effect on certain obstinate surface lesions.

Baths.—Mercurial baths have been employed in the treatment of syphilis, but the method has never been extensively used, although obstinate cutaneous lesions are sometimes benefited by a course of such baths. From 2 to 4 drams of bichlorid of mercury may be dissolved and added to the tub bath containing 20 to 25 gallons of water, the patient remaining immersed ten to twenty minutes.

The baths may be used alone, but are inferior in every way to the other methods of administration. They may be advantageously employed, however, as an adjuvant to the other treatment in cases complicated by obstinate or extensive skin lesions.

It is a matter of general observation that ordinary hot baths during the administration of mercury have a beneficial effect, and appear to assist the action of the drug.

3. **Hypodermic Administration.**—Within recent years, strong claims for this method have been put forward from time to time. Its advocates claim many advantages over other methods of administering mercury. Among these are:

(1) The treatment is entirely in the hands of the medical advisor, thus eliminating such factors as the forgetfulness or indifference of the patient. (2) The amount of mercury administered is small, the dosage small; hence salivation is infrequent and the amount absorbed into the system is definite. (3) Disturbances of the alimentary canal are avoided. (4) The annoyance of inunctions is overcome. (5) The treatment may be carried out without exposing the nature of the disease to the patient's friends. (6) Such other minor claims, as lessened inconvenience, decreased cost, etc., may be ignored.

On the other hand, these claims are not admitted by many eminent authorities, and, in addition, there are certain disadvantages connected with the method that must be well considered. These are:

(1) The injections are so painful in some instances that the patient does not return for further treatment, or refuses to allow subsequent injections. (2) The patient is obliged to keep in close touch with his physician—almost an impossibility for people in certain lines of business.

(3) Violent reaction follows the injection in some cases, resulting in painful, disabling swellings or even abscesses. (4) In rare instances, from unusually rapid absorption, marked toxic symptoms appear.

Of 400 injections, Dr. Portalier found a slight attack of fever with malaise, prostration, and insomnia, lasting for two or three days 102 times. In 6 cases there was a good deal of temperature with signs of gastric disturbance.

These injections, as a rule, set up local reaction in one of the following forms: Swelling and induration generally appear a day or two after the injection, and vary in degree and character; in the series of 400 injections, mentioned above, they were slight 152 times, moderate without redness 162 times, quite considerable with slight redness 57 times, considerable and inflammatory 10, absent 6 times. They begin to subside about the fourth day, and finally all that is left is a small lump or node. In rare cases the reaction is so great as to lead to a diagnosis of a deep and extensive abscess, but in a few days the condition straightens itself out.

As the inflammation following these injections subsides, a lump or node often remains. The size varies from that of a chestnut to an egg, or even larger. Usually the node disappears gradually, but sometimes persists for many months. Fournier's experience is that the nodes occur after the injections in two-thirds of the cases.

Abscesses are very rare, owing to the care used in making the injections; the proportion being but little more than 1 per cent. in 1410 injections.

As to the amount of pain following injections, writers differ widely. Without quoting the opposing views, Dr. Portalier was requested by Fournier to note with great care the amount of pain in the private patients they were treating. The results were: Atrocious, intolerable pain, 12; very severe, 72; moderate and tolerable, 155; slight, 149; none, 12. In 245 injections in hospital practice, the pain was severe or very severe in half of the cases, and moderately tolerable or insignificant in the other half. In the second series of 473 cases the results were: Intolerable, 13; very severe or severe, 137; moderate, 79; slight, 125; insignificant or none, 119. In more than 50 per cent. the pain was an important matter.

A certain number of patients absolutely refuse to continue the treatment.

Vose states that in 1373 persons treated with 13,671 intramuscular injections of insoluble mercurial salts, suspended in paraffin, embolism occurred fifteen times. The proportion was one embolism to each 91 subjects. The salt generally used was salicylate of mercury in a .05 or .01 per cent. suspension in paraffin. The symptoms were, fortunately, slight and transient.

As to the efficiency of the hypodermic treatment, the experience of C. F. Marshall at the Lock Hospital is significant—69 cases were under treatment for more than a year; 37 were treated by intramuscular injections until all symptoms disappeared, and then 2-gr. blue pills given internally; 16 of these had relapses and 4 had iritis.

Thirty-two cases were treated by inunctions while symptoms lasted, and then the blue pills were substituted. Of these there were but 7 relapses and but 1 case of iritis.

Such claims as the certainty of the amount of mercury absorbed, the larger percentage of cures, etc., do not appear to us to be established. The disadvantages of this method certainly quite counterbalance the supposed advantages. The method is not suitable for the routine treatment of syphilis. It should, however, undoubtedly be accorded a place in the therapeutics of the disease. When the internal administration is not well borne, or when the patient is so irresponsible or indifferent as to neglect taking his medicine regularly and inunctions cannot be employed, the hypodermic method may serve a very useful purpose. Also in some cases in which the lesions do not respond to the usual treatment, this method may give brilliant results.

Many preparations of mercury have been thus employed. They are divided into the soluble and the insoluble.

The usual dose of calomel for an injection is ½ to 1 gr. It may be suspended in 10 to 15 minims of glycerin, glycerin and water, or any bland oil. A useful formula is: Calomel and sodium chlorid, each 1 part; distilled water, 10 parts.

Corrosive sublimate may be used in doses of from $\frac{1}{12}$ to $\frac{1}{8}$ gr. dissolved in 10 minims of distilled water.

Both the black and the yellow oxids of mercury have been used. They may be made into a mixture suitable for injection by incorporating with olive or almond oil, glycerin and water, or gum acacia and water. Oleum cinereum, or gray oil, and metallic mercury are also used.

The soluble preparations of mercury besides the bichlorid are: Peptonate, biniodid, salicylate, succinamid, sal. alembroth, and sozoiodol.

Some typical formulas are the following:

℞. Hydrargyri chloridi corrosivi.....gr. ivss 0|30
Sodii chloratis.....iiiss 0|23
Aquæ destillatæ.....f℥j 30|00.—M.
Sig.—1 per cent. solution. Dose, 10 to 20 minims.

℞. Hydrargyri chloridi corrosivi.....gr. ivss 0|30
Glycerin,
Aquæ destillatæ.....āā f℥ss 15|00.—M.
Sig.—1 per cent. solution. Dose, 10 to 20 minims.

℞. Hydrargyri chloridi corrosivi.....gr. ivss 0|30
Acidi tartarici.....gr. xx 1|33
Aquæ destillatæ.....f℥j 30|00.—M.
Sig.—1 per cent. solution. Dose, 10 to 20 minims.

℞. Hydrargyri chloridi corrosivi.....gr. xvj 1|0
Ammonii chloridi (C. P.).....gr. viij 0|5
Aquæ destillatæ.....f℥j 30|0.—M.
Sig.—Sal. alembroth. 10 minims = ⅓ gr.

℞. Neutral mercury salicylate.....1|0
Liquid albolene.....10|0.—M.
Sig.—Put in small vials (15 cc.). Cork securely and sterilize by heat. Dose, 3 to 10 minims every seven to fourteen days, as required by the individual case (Gottheil).

℞. Sublimed calomel.....6|50
Sterilized olive oil.....10|00.—M.
Sig.—Average dose, 10 to 15 minims—.033 to .05 gm. calomel—(Fournier).

℞. Calomel.....gr. lxxv 5|0
Wood creosote,
Camphoric acid.....āā ℥iiss 10|0
Palmitin, enough to make.....℥iij 100|0.—M.
Sig.—Dose, 10 gr. = ½ gr. of calomel (Lambkin).

℞. Sozoiodol of mercury.....gr. xi½ 0|75
Sodium iodid.....gr. xxiiss 1|50
Aquæ destillatæ.....f℥j 30|00.—M.
Sig.—Dose, 10 to 15 minims.

℞. Hydrargyri chloridi mitis,
Liquid vaselin,
Lanolin.....āā ℥j. 4|0.—M.
Sig.—Dose, 3 gr. (1 gr. calomel).

℞. Hydrargyri oxidi flavi.....gr. xx 1|33
Pulveris acaciæ.....gr. iv 0|26
Aquæ destillatæ.....f℥j 30|00.—M.
Sig.—Dose, 15 minims.
Gray oil. Dose, gr. ss to iss.

℞. Metallic mercury (by weight),
Wood creosote,
Camphoric acid.....āā ℥iiss 10|00
Palmitin, enough to make.....℥iij 100|00.—M.
Sig.—10 gr. = 1 gr. of metallic mercury. (Lambkin.)

The following advantages are claimed for this preparation: It is non-irritant; not easily oxidized; as palmitin is a normal constituent of the human body it does not act as a foreign substance. As a vehicle it is more homogeneous than any other; its melting-point may be raised or lowered.

Dose.—One grain of mercury once a week. Lambkin gives six weekly injections, then two months' rest; four weekly injections, two months' rest; four injections, two weeks apart, four months' rest; four injections, two weeks apart, six months' rest; four injections, one month apart, one month's rest; four injections, two weeks apart. Total number of injections 18, covering a period of two years.

Technic of the Injection Method.—It is unnecessary to say that the most absolute asepsis must be observed. The solution injected being an irritant, the vitality of the tissues with which it comes in contact is much reduced and a tendency to necrosis always exists. The addition of micro-organisms would almost certainly result in abscess formation.

(*a*) *The Syringe.*—The syringe should be so constructed that it may be boiled, as this method of sterilization is so far superior to all others. Metal syringes, however, are unsuitable on account of the corrosion which results from the action of the mercurial preparation. The most suitable form of syringe is that made entirely of glass, and having a platino-iridium needle. A steel needle may be used, and if carefully cleaned and dried immediately after each injection may last some time. The former, however, are preferable.

(*b*) *The Injection.*—For the reasons given, the surgeon should thoroughly cleanse his hands and all utensils to be employed in making the injection. The point at which the injection is to be made should be prepared by scrubbing well with soap and warm water, and then with 95 per cent. alcohol. The injection may be made in the loose subcutaneous cellular tissue or into the muscles. The latter is usually to be preferred. In making an intramuscular injection, a muscle should be selected the function of which is not very essential to the individual. The upper part of the gluteal region will generally be the most convenient site. The needle should be introduced at a right angle to the surface and the fluid deposited deeply in the muscle. Inasmuch as serious consequences may result from injecting the mercurial preparation directly into a vein, care should be taken to prevent such an accident. This is best guarded against by introducing the needle in the usual way to the desired depth and the syringe then disconnected. If the point be in a lumen of a vein, blood will flow from the needle. In this case, withdraw the needle somewhat or insert it deeper, and when it is apparent that the vessel has been cleared, the syringe may be connected and the injection made. When the needle has been withdrawn, the puncture should be sealed with collodion.

The injections are usually made about once a week until all symptoms of the disease have disappeared, when the intervals may be increased to two weeks. The frequency must be governed by the tolerance of the patient and the effect of the lesions.

Hydrargyrism, Salivation, Ptyalism.—When the dose of mercury exceeds the physiologic limit of the individual, ptyalism usually develops. This condition is indicated by a persistent metallic taste in the mouth, an increased flow of saliva which is more viscid than normal, slight tenderness and sponginess of the gums with a tendency to bleed easily, some fetor of the breath, and an inability to bite firmly on account of tenderness of the tooth-sockets. If the mercury be still continued, the symptoms mentioned are all aggravated. The gums become much swollen and ulcerated, the teeth loosen, the tongue swells, the submaxillary glands become enlarged and painful, and swallowing becomes difficult.

Treatment.—It need scarcely be said that the mercury should be stopped at once if any of these symptoms appear. Atropin sulphate, $\frac{1}{200}$ to $\frac{1}{150}$ gr., may be given internally every six to eight hours. Mouth-washes must be used. These may be composed of boric acid, borax, chlorate of potash, alum, glycerite of tannic acid, etc. The more severe the ptyalism, the greater the need of an astringent application. The lotions should not be made too strong. Better results will be obtained by the free and frequent use of mild solutions than by the less frequent application of stronger remedies. Twice daily, after a thorough cleansing, the inflamed mucous membrane may be swabbed with a solution of silver nitrate 5 to 10 gr. to the ounce. With this treatment the condition should rapidly improve.

Disturbances of the Alimentary Tract..—When administered by the mouth, mercury may cause digestive disturbances—loss of appetite,

eructations and gastric distress, or abdominal cramps and diarrhea. If these continue, the general health suffers, as shown by debility, emaciation, anemia, and neurasthenia. Under such conditions, if the patient has been taking full doses of mercury for some time, the drug may be temporarily discontinued, while appropriate measures are adopted for the digestive disturbance. In many cases, however, these symptoms will appear early in the treatment and from moderate or even small doses of mercury. Under such conditions, and the instances are numerous, an effort should he made to establish what might be called a normal tolerance of the drug by ordering a diet that will be easily digested and assimilated, and restricting articles that have a laxative effect, such as fruits and green vegetables. If the digestion continues to be impaired, it will be necessary to administer the drug in some other manner—inunction or hypodermic injection. For continued looseness of the bowels and cramps, a small dose of opium may be administered, although this is objectionable and should be regarded merely as a temporary expedient. This may be given in pill form or, preferably, as paregoric, 20 to 30 drops being taken as frequently as necessary to control the symptoms. If a carefully regulated dietary and very small doses of opium do not control the diarrhea, the administration of the drug by the mouth will have to be discontinued and one of the other methods of treatment adopted.

Serum Treatment of Syphilis.—Attempts have been made by a number of investigators to find a specific serum for syphilis. Among these may be mentioned Feulard, Tommasoli, Kollmann, Sartori, Bonaduce, Pellizzari, Mazza, Risso and Cipollina, and De Lisle.

Tommasoli employed the serum from lambs' blood, Sartori, from the ox; Kollmann, from sheep, dogs, calves, and rabbits; Mazza, from guinea-pigs; Risso and Cipollina, from dogs; while Bonaduce used serum from cases of hereditary syphilis, and Pellizzari from subjects with acquired syphilis.

The serum is obtained by injecting the blood of a person in the secondary stage of syphilis (before treatment has been begun) under the skin and into the peritoneal cavity of animals at intervals of a few days for two or three weeks. A week after the last injection the serum is obtained by bleeding the animal. Coutts suggests that the serum be obtained from mothers who have born syphilitic children, but who have themselves shown no sign of the disease.

While some writers report gratifying success, the results so far are rather contradictory. Much more work must be done before an authoritative opinion can be ventured as to the value of this treatment.

Dioxydiamidoarsenobenzol (**"606"**).—As all efforts to produce an immunizing or curative serum for such diseases as syphilis have failed up to this time, Ehrlich assumed that some substance might be discovered which, when introduced into the system, would destroy the germs causing the disease without being toxic to the individual. Beginning with atoxyl as a basis, he has experimented with a vast number of compounds. The 606th distinct preparation seemed to

possess the desired qualities, hence the popular name. The substance is a crystalline powder, having a yellow color. As it is decomposed by oxygen it is put up in vacuum tubes. It is administered hypodermically, either subcutaneously, intramuscularly, or intravenously, the intramuscular injection in the gluteal region being the method of choice. The usual dose is 0.2 to 0.5 gm. The preparation of "606" for administration is somewhat complicated, and already a number of modifications have been suggested. A single dose is supposed to be sufficient, but, owing to relapses, some cases have received a second administration. It has also been suggested that repeated smaller doses may be found more advantageous.

The number of cases reported at this time probably total several thousands. The prevailing opinion of the value of "606" is distinctly favorable. Some writers speak of its curative influence as brilliant. Many reports state that the spirochætæ disappear from the chancre and from enlarged lymph-nodes two or three days after the injection. Superficial lesions are said to disappear in a few days, and papular and pustular lesions in three or four weeks. Scleroses and adenites require a longer time, but the effect of the drug may be noted almost immediately. Very satisfactory results are reported in the tertiary stages and also in hereditary syphilis.

On the other side of the account, it is stated that there is always a definite rise of temperature following the injection, which lasts, even in favorable cases, about three days. Considerable local pain and swelling, as a rule, follow the injection. For the relief of the pain morphin is often required, and occasionally for several days. The induration is usually well marked by the third or fourth day. The intravenous injection is said to be followed in two or three hours by a chill, a rise of temperature, pains in the limbs, and, in some cases, by vomiting and diarrhea. Collapse has been noted after the administration of "606," and a few deaths have been reported.

Serious, non-syphilitic disease of the optic nerve and retina, heart, blood-vessels, lungs (except tuberculosis), kidneys, and nervous system positively contraindicate the use of this drug. The use of "606" may be combined with the administration of mercury by the ordinary methods.

Whether the remedy will survive the test of time the future alone can decide. If the present preparation is not found to be a real specific for syphilis, some modification or substitute may prove to be. Already Ehrlich has brought out another compound which he has called "Hyperideal." Until this question is settled the general practitioner should follow the older methods of treatment, leaving the use of these new compounds to the experimenters and well-qualified specialists.

To summarize the foregoing, we believe that administration by the mouth meets all the requirements in the average case with the minimum of objections. It has been the custom of the writers to alternate six weeks of internal administration with two weeks of inunctions. This has the advantage of relieving the alimentary tract at stated

periods, and at the same time the treatment is not interrupted. We believe it is somewhat more effective than the treatment continuously by the mouth. It should, therefore, be employed as a matter of routine and certainly whenever the manifestations have not yielded properly to the latter form of administration. The administration of mercury by inunction is perhaps the most promptly effective treatment in the early stages of syphilis. It cannot be carried out in a larger proportion of the cases, however, because patients will not submit to the necessary inconvenience in many instances. Baths and fumigations, while employed by a very small minority of syphilographers, have never come into general use; they may be employed, however, with advantage in some cases (see p. 475). Hypodermic injections of mercury may serve a useful purpose in the cases that resist the usual forms of treatment (see p. 475, also footnote, p. 472).

THE ADMINISTRATION OF IODIDS

C. Tertiary Stage (Tuberculo-ulcerous Syphilids, Gummata, Periostitis, Ostitis, Arthritis, Lesions of the Nervous System, etc.).—Iodids are not given for primary or secondary manifestations. They are employed in all tertiary lesions, in precocious cases (p. 461), and also as a routine after the mercurial course in all cases of syphilis. Therefore, after the latter drug has been given for from one and a half to two years, according to the preceding directions, the iodids are added to the treatment (mixed treatment). This applies to every case—to those that have shown no new outbreak during treatment, as well to those who have had recurring lesions. The mixed treatment is also usually given for tertiary manifestations. Either potassium iodid or sodium iodid may be selected. The former is generally employed, probably from habit. The sodium salt is apparently equally efficient, and not quite so depressing to the system as the potassium compound. In a strong individual taking moderate doses, this consideration would have no weight, but for persons who are much reduced and who are obliged to take heroic doses, it becomes a very important matter.

Mixed Treatment.—In giving mercury and the iodids together, either the biniodid or the bichlorid[1] of the former is combined with one or more of the salts of the latter. A common prescription for this "second course" is:

℞. Hydrargyri biniodidi.....gr. ij 0|15
Potassii iodidi.....ʒiv 16|00
Aquæ.....q. s. ad ʒiij 100|00.—M.
Sig.—fʒj in water three or four times a day, according to the effect, preferably after food.

Or, if it be desired to modify the unpleasant taste, or to disguise the remedies, equal parts of water and compound syrup of sarsaparilla may be used as a vehicle. Thus:

[1] These two salts may be used interchangeably in this combination. The biniodid is very slightly soluble in water, but is freely soluble in combination with potassium iodid. When bichlorid of mercury is added to potassium iodid, it is at once converted into the biniodid, so that the final result is the same as if the biniodid had been used.

℞. Hydrargyri biniodidi.....gr. ij 0|15
Potassii iodidi.....ʒiv 16|00
Syrupus sarsaparillæ compositi.....fʒiss 45|00
Aquæ.....q. s. fʒiij 100|00.—M.
Sig.—To be taken in the same dose as the foregoing.

The bichlorid of mercury may be substituted for the biniodid in the same doses.

The dose of mercury varies within rather narrow limits, but the quantity of iodid is subject to considerable variation. For this reason it is often advantageous to give the two remedies separately, which permits of either being increased or diminished, as circumstances demand.

When given separately the biniodid or bichlorid may be administered in the form of pills, and the iodid in solution, as:

℞. Sodii iodidi.....ʒj 30|00
Aquæ.....q. s. fʒij 60|00.—M.
Sig.—gtt. ij = 1 gr. Dose, 20 drops and upward, according to circumstances.

The iodids should be taken well diluted with water, and preferably after food. If the taste is very objectionable, the drug may be given in milk instead of water. If the drug disagrees with the stomach, 2 teaspoonfuls of the essence of pepsin or wine of pepsin may be given with each dose.

The iodid may be administered by the mouth and the mercury by inunction. In fact, this is perhaps the most effective way to exhibit the two remedies, and should always be employed in the obstinate and rebellious cases. Again, the mercury may be given by hypodermic injection or by fumigation or baths, and the iodid as above stated.

The "mixed treatment" or "second course" should be given in one of the ways mentioned for three months; then discontinued for two weeks, and resumed for two months; then every alternate month for one year, the entire period of treatment of a case of syphilis running a favorable course extending over a period of two and a half to three years. In cases in which syphilitic lesions recur from time to time, the treatment should be continued from six months to one year after the disappearance of the last symptoms of the disease (see foot-note, p. 472).

In giving the mixed treatment the indication is the same as that governing the use of mercury in the earlier stages, namely, to administer the largest dose the patient will tolerate without unpleasant symptoms. The average dose of the biniodid or bichlorid of mercury, as stated, is $\frac{1}{24}$ to $\frac{1}{12}$ gr., three or four times a day. In a few cases this may have to be increased. On the other hand, cramp-like pains in the abdomen, borborygmus, diarrhea, or salivation would indicate a reduction in the dose.

The iodid is given in doses of from 5 gr. upward; 10 gr., three or four times a day, being an average dose. When, however, tertiary lesions are not favorably influenced by this quantity, the amount may be cautiously increased until the daily dose reaches as much as 1 ounce. Such enormous quantities will rarely be needed, but the surgeon should

not hesitate to push this remedy, in the absence of toxic symptoms, until the disease yields, as it usually will if the general health be properly attended to and the treatment intelligently conducted.

Iodism.—The toxic effects of the iodids are: Coryza, lacrimation, sneezing, injection of the conjunctivæ, gastro-intestinal disturbances, skin eruptions, general depression, etc. The skin lesions may be papular, pustular, tubercular, bullous, or ulcerative. The latter appear in the most pronounced examples of iodin toxemia. The variation in the susceptibility to the iodids is much greater than in the case of mercury. As Hutchinson says: "There is no remedy in which idiosyncrasy counts for so much and in which the dose may vary within such wide limits—sometimes minute doses (1 gr. or even $\frac{1}{3}$ gr.) will exercise as definite a curative influence as thirty times the quantity may do in another patient."

The appearance of toxic symptoms is an indication to reduce the dose or withdraw the medicine entirely for a time. In some cases large doses of iodid are required to affect obstinate lesions, and clear judgment will be demanded to decide when the drug may be pushed and when it must be withdrawn.

Treatment.—In the milder forms of iodism the symptoms will speedily disappear after the drug is withdrawn. In the more advanced cases, the patient will need tonics to overcome the depressing effects of the overdoses of iodids.

THE RELATION OF SYPHILIS TO MARRIAGE

Authorities differ as to the time when it may be considered proper for a person who has had syphilis to marry. The statements of writers vary from two and a half to four or even five years after the date of the infection. While those who permit their patients to marry at the end of two or two and a half years support their position with arguments more or less plausible, it is unquestionably a safer rule to adhere to the longer period. The physician should not, as a rule, therefore, give his consent to the marriage of a syphilitic earlier than four years from the beginning of the disease.

Unfortunately, the physician's advice on this subject is not always sought, or, if obtained, is not invariably followed. If a syphilitic person should marry before the time specified, or if the disease be acquired after marriage, every effort should be made to prevent conception until the expiration of the period indicated. At the same time, under these circumstances, the patient should be kept under the closest scrutiny by his physician, and the treatment must be pushed with all proper activity. The latter will be carried out on exactly the same lines as already described. It is not without value, if the risk of impregnation is unavoidable, to place the unaffected partner under mercurial treatment, it being usually possible to give the drug in the guise of a "tonic."

In this connection it should also be remembered that mucous patches

are infectious, and the partner is to be protected from this source of infection.

In the event of impregnation occurring while either party is still in the infecting stage, the fetus will undoubtedly be syphilitic unless the mother is under active treatment throughout the whole period of pregnancy; the nearer the date of conception to that of the infection, the more marked will the manifestations be; while the farther apart these two periods, the milder the symptoms. In either case, the mother should be treated throughout the period of gestation. The earlier in the disease the impregnation takes place, the more active must be the treatment. If the mother be syphilitic, she should be treated for the proper period and as described above. If the source of the infection be the father, not only will the child probably be syphilitic, but the mother will also be contaminated, although in some instances no manifestations will appear. In such a case the mother should be treated for the full two or two and a half years from the time of conception. If a patient should have been pregnant some time before coming under the care of a physician, and it appears that the father is syphilitic, no time should be lost in bringing her under the influence of mercury.

It may be repeated here that the inunction of mercurial ointment is often the most effective treatment for the secondary stage of syphilis, and it is particularly indicated for the class of cases under consideration.

It is unnecessary to state that in some of these cases the treatment must be carried out without indicating to the patient the real trouble, and that tact of the highest order will be required to secure the cooperation and interest necessary for effective medication without disclosing the reason for such solicitous care.

OPEN-AIR TREATMENT FOR SYPHILIS

Douty advocates the open-air treatment for syphilis, in addition to the mercurial medication, for the same reason that it is recommended in cases of tuberculosis. An abundance of pure air and direct sunlight improve the quality of the blood, increase metabolic activity, and raise the tone of all the tissues of the body.

It should certainly be employed in cases that do not do well on medication alone. A plain, nutritious diet should be taken, and tonics prescribed as indicated. The various functions of the body also demand attention.

MALIGNANT SYPHILIS

In a few cases of syphilis the ordinary methods of treatment seem to fail entirely to control the symptoms. Sir Alfred Cooper, among others, advocated the Zittmann treatment where other methods have failed. It is said to be indicated in cases of severe and rapid ulceration causing much destruction of tissue and general exhaustion. In some cases two weeks' treatment is said to have arrested the progress of the disease and brought about rapid healing. The evening before treatment

is begun the patient takes 2 gr. of calomel, 5 gr. of colocynth, and 2 gr. of hyoscyamus. The medicine consists of two decoctions, a stronger and a milder. In the morning ½ pint of the stronger decoction is given, hot, at 9, 10 and 11 o'clock; and in the evening ½ pint of the milder decoction, cold, at 3, 4, 5, and 6 o'clock. The patient is kept in bed in a warm room, and the treatment repeated for four days. On the fifth day he gets up and takes a hot bath. In the evening, two pills are taken, as in the beginning, and the decoctions are continued on the next day. The treatment lasts fifteen days.

The formula of Zittmann's decoction, as given by different writers, varies so greatly that it is impossible for one to decide which represents the approved preparation. This confusion undoubtedly arises from the fact that the composition has been changed from time to time, especially by those who made an effort to popularize this treatment by "improving" the original formula.

The following, from the Pharmacopœia Germanica, Second Edition (1883), may be accepted as the standard:

DECOCTUM SARSAPARILLÆ COMPOSITUM FORTIUS (STRONGER ZITTMANN'S DECOCTION)

Sarsaparilla, cut moderately fine	100 parts.
Water	2600 "

Digest for twenty-four hours at 35° to 40° C., and add:

Sugar	5 parts.
Alum (potash)	5 "

Expose them in a covered vessel, with occasional stirring, for three hours to the heat of boiling water, on a water-bath, then add to the mixture:

Anise, bruised	5 parts.
Fennel, bruised	5 "
Senna, cut	25 "
Liquorice root, cut	10 "

Digest for one-quarter hour on a water-bath and strain the liquid, with expression. Allow the decoction to settle, then pour off the liquid, and, by the addition of water, bring it to 2500 parts.

The dose of this decoction is from 200 to 500 cc. (7–17 f℥) per day, generally in two draughts. Some prefer to give the morning portion warm and the evening portion cold; others prescribe that both draughts shall be warm, and still others, that both shall be cold.

The decoction is also prescribed in conjunction with measures to produce free diaphoresis—the so-called "sweat-cure."

DECOCTUM SARSAPARILLÆ COMPOSITUM MITIUS (MILD ZITTMANN'S DECOCTION)

Sarsaparilla, cut	50 parts.
Water	2400 "

Digest for twenty-four hours and expose in a covered vessel, with occasional stirring, for three hours, to the heat of boiling water, on a water-bath. Then add to the decoction:

Lemon peel, cut	5 parts.
Cinnamon, bruised	5 "
Cardamom, bruised	5 "
Liquorice root, cut	5 "

Digest for one-quarter hour and strain the liquid, with expression. Allow the decoction to settle; then pour off the liquid, and, by the addition of water, bring it to 2500 parts.

In the Third Edition of the Pharmacopœia Germanica (1890) the milder decoction has been omitted, the formula of the stronger remaining unchanged.

The Decoctum sarsaparillæ compositum of the United States Pharmacopœia is supposed to represent all the virtues of Zittmann's decoction. The formula follows:

DECOCTUM SARSAPARILLÆ COMPOSITUM

Sarsaparilla, cut and bruised	100 gm.
Sassafras, in No. 20 powder	20 "
Guaiacum wood, rasped	20 "
Glycyrrhiza, bruised	20 "
Mezereum, cut and bruised	10 "
Water, sufficient, to make	1000 cc.

The dose is 4 to 5 fluidounces, three or four times a day.

This preparation is not as palatable as that made after the German formula, on account of the acrid taste of the mezereum, which probably adds nothing to its therapeutic value.

HEREDITARY SYPHILIS

At birth the syphilitic child may be small, stunted, emaciated, weazened, and senile in appearance. While such a condition would give rise to a strong suspicion of hereditary disease, it might result from any other condition which caused marked disorder of nutrition on the part of the mother or child. The most common cutaneous affection at this period is the bullous eruption affecting the palms and soles, and even the entire surface of the body. Both liver and spleen will be found to be enlarged. In a great many cases, perhaps the majority, syphilitic children appear healthy and well nourished at the time of birth. In these instances the first symptoms of the disease appear, as a rule, in from six weeks to three months, and consist of the following in the order of frequency:

(1) Marasmus; one must distinguish cases due to syphilis from those depending upon gastro-intestinal derangements.

(2) Coryza (snuffles), hoarseness; these occur in about three-fourths of all cases. Acute, simple coryzas, adenoids, and non-specific catarrhs must be excluded.

(3) Syphilodermata; these appear soon after the snuffles, they are usually polymorphous, the prominent characteristics being macular, papular, pustular, and bullous.

(4) Enlargement of the liver and spleen.

(5) Mucous patches on the tongue, cheeks, tonsils, and pharynx.

About the time of the subsidence of the rash an enlargement of the ends of the long bones may be noticed, which is due to epiphysitis.

If these symptoms do not appear before the eighth month, it is probable that the child will escape altogether, or that the secondary stage has been very mild and altogether intra-uterine. During adolescence the following symptoms, if unmistakable, may be considered pathognomonic:

(1) Dwarfed, permanent, median, upper incisors, broader at the top than at the cutting edge, the latter being crescentically notched, and the teeth separated by an undue interval and converging toward each other.

(2) Evidence of past or present interstitial keratitis—a dusky and thin sclerotic in the ciliary regions, and slight clouds here and there in the corneal substance, there being no scars on its surface—or of disseminated choroiditis; patches of absorption, especially around the periphery.

(3) A radiating series of narrow cicatricial scars extending across the mucous membrane of the lips or a net-work of linear cicatrices on the upper lip and around the nostrils, as well as at the corners of the mouth and on the lower lip.

Treatment of Hereditary Syphilis.—A syphilitic child should not be allowed to suckle any woman except its mother, as the disease may be transferred to a healthy person in this way.

The later the stage of the disease in the parent at the time of conception, the better nourished and more healthy will the child probably be. As a rule, however, unless the mother has been thoroughly treated during her pregnancy, children born to syphilitic parents are weakly, impoverished, or weazened. It should be an invariable rule, therefore, to place such infants under the most favorable hygienic conditions. The nutrition should be kept at the highest possible point. As ulcerations of the mouth, nose, genitalia, and anal regions are prone to occur, these parts must receive particular attention. The mouth may be cleansed after each feeding with boric acid solution (10 to 15 gr. to 1 ounce of water) and the nose syringed with the same fluid if needed.

The genital and anal regions must be cleansed frequently, dried, and dusted with talcum powder to prevent maceration of the skin.

If a child shows evidence of inherited syphilis at birth, treatment should be begun at once. This may be administered by applying $\frac{1}{2}$ dram of a mixture of mercurial ointment, 1 part, and vaselin, 3 parts, on a binder which is to be worn about the abdomen. Each day the skin should be bathed with soap and warm water, and a fresh portion of salve applied on the binder. Mercury may be given internally, as in either of the following formulas:

℞. Hydrargyri cum creta.....gr. j 0|065
Sacchari lactis.....gr. xij 0|8.—M.
Ft. ch. No. xii.
Sig.—Three to six daily.

℞. Hydrargyri chlor. mitis.....gr. ij o|13
Sacchari lactis.....gr. xij o|8.—M.
Ft. ch. No. xii.
Sig.—Three to six powders daily.

The powder may be placed on the tongue just before the child nurses. More frequently, however, these children showing marked evidences of syphilis at birth are either still-born, or survive but a short time, so that the question of treatment for this class does not frequently arise. A syphilitic child that has a chance of surviving usually presents no definite signs of the disease at birth. As the condition will not be suspected in many instances, treatment will naturally not be begun until some manifestation appears. If the attending physician knows that either parent is still in the early stages of syphilis, it would be proper to begin a mild course of medication, even if the child did not show any symptoms. If it thrived well and gained in weight, the treatment should be continued. If the parental disease be in the later stages, and if a thoroughly systematic course of treatment has been followed, no antisyphilitic remedies need be given to the child until some indication presents itself. It is necessary to watch suspected cases carefully in order to observe the earliest manifestation. This should include the weighing of the child at regular intervals.

The systematic treatment of a case of inherited syphilis should begin as soon as any symptoms of the disease appear, whether this be at birth or at a later period. The condition of the child will determine to some extent the choice of the mercurial preparation. For the more pronounced lesions, the inunctions of mercury will be found most efficacious. These are applied on a binder as directed on p. 488 in the case of infants. Older children may be treated in the same manner as directed for adults (p. 468), excepting that the mercurial ointment should be used one-half strength instead of full strength. If the ointment causes a dermatitis, either when used on a binder or by inunction, it must be discontinued, and the administration continued by the mouth until the skin has healed.

In the milder forms of the disease, or when the inunctions cannot be used, internal treatment may be substituted,—*i. e.*, protiodid, $\frac{1}{20}$ to $\frac{1}{10}$ gr.; tannate, $\frac{1}{20}$ to $\frac{1}{10}$ gr., etc. It is merely the question of securing the introduction of a certain amount of mercury into the system, with the least harm and inconvenience to the individual.

In many cases it may be necessary to give tonics, either in combination with the mercury or separately. The child's weight may be accepted as a fair index of the success of the treatment. A gradual and normal increase, with the general appearance of health, would indicate that the treatment was efficient and should be continued. To no class of syphilitics would the "open-air" treatment be more beneficial than to children with inherited syphilis.

In some cases, potassium or sodium iodid is indicated. The more the lesions conform to the tertiary type of the acquired disease, the more

strongly the iodid is indicated. Among such manifestations may be mentioned the affections of bones, joints, the nervous system, etc.

The combination of mercury and iodin may be the following:

℞. Hydrargyri bichloridi.....gr. j 0|065
Potassii iodidi.....ʒij 8|
Syrupi zingiberis,
Aquæ.....āā ʒj 30|00.—M.
Sig.—For infants, 5 to 10 drops. Six months to one year, 10 to 20 drops.

During the administration of the medicine a close watch must be kept for evidences of the toxic effects of either of the drugs, and the medicine withdrawn, or the dose reduced, according to the indications. Both the mercury and the iodid may cause gastro-intestinal derangements, and the latter, if given in too large doses, also causes coryza and papular or pustular skin eruptions. When the alimentary tract is irritated, if the diet, etc., be properly regulated, the trouble may subside without withdrawing the medicine. The symptoms of iodism call for a reduction in the size of the dose.

Hypodermic injections of mercury have been given for inherited syphilis, but it will be very seldom that this method will be preferred to one of the other forms of treatment. For infants, $\frac{1}{50}$ gr. may be given; at one year, $\frac{1}{40}$ gr.; two years, $\frac{1}{30}$ gr.

In the presence of marked skin eruptions, mercurial baths are sometimes advantageous—$7\frac{1}{2}$ gr. each of bichlorid of mercury and chlorid of ammonium may be dissolved in 8 gallons of tepid water, and the child allowed to remain in this five minutes at first. The strength of the bath may be cautiously increased and the time prolonged to ten minutes, as it is seen that the child stands them well. Local lesions require treatment on antiseptic principles, being careful, however, to use the antiseptics so weak as to avoid the danger of doing harm.

In many of the cutaneous lesions a dusting-powder will be found most serviceable. For this purpose zinc stearate alone or in combination with a small proportion of calomel will be useful. In a similar manner, oxid of zinc, starch, and talcum may be employed. In cases in which a salve is required, the white precipitate ointment (ung. hydrarg. ammoniat.) may be used, diluted one-fourth or one-half with vaselin, or in either of the following combinations:

℞. Hydrargyri ammoniati.....gr. xv 1|0
Unguenti zinci oxidi.....ʒj 30|0.—M.

or

℞. Hydrargyri ammoniati.....gr. xv 1|0
Unguenti aquæ rosæ.....ʒj 30|0.—M.

Lesions of mucous membrane may be cleansed with boric acid solution (10 gr. to fʒj of water).

Granulating surfaces may be stimulated by the application of silver nitrate solution (gr. x to xxx to fʒj of distilled water).

GONOCOCCIC INFECTION

By Edward Martin, M. D.

The specific nature of gonococcic infection, evidenced by the clinical history of the disease, was generally recognized after Neisser, in 1879, published a description of the gonococcus, its size, conformation, grouping, and method of growth, and the constancy with which it was found in cases of gonorrhea. That the bacterium described was the sole and invariable cause of the infection was conclusively proved by Bumm (1887), who produced pure cultures, which, on implantation upon the mucosa of a healthy urethra, caused gonorrhea.

In addition to its specific reaction to the colors, its characteristic grouping within the leukocytes, its cultural peculiarities, and its predilection for acid media, the Neisserian diplococcus is readily killed by drying, by comparatively brief exposures to a temperature either below 10° C. or above 40° C., and by dilute antiseptics, particularly solutions of the silver salts.

Placed on the surface of the healthy mucosa of the genito-urinary tract the gonococcus multiplies, penetrates, spreads, and causes inflammatory symptoms, which run a characteristic clinical course; often complicated by a bacteremia expressed by constitutional symptoms and by involvement of the serous membranes, joints, the endocardium, muscles, bones, and, exceptionally, the spinal cord.

Pure culture of gonococcus injected into a joint shows no tendency toward growth, and shortly perishes, producing only transitory inflammatory symptoms commensurate with the amount of irritating endotoxins contained in the gonococci injected. From the metastatic expression of gonococcal bacteremia the specific organism can, as a rule, be recovered but for a short time, though the evidences of chronic inflammation may persist for years.

The mucosa of the genito-urinary tract and the conjunctiva (particularly that of infants and children) offer favorable conditions for growth and long persistence of gonococci. They may also be implanted upon the oral or rectal mucous membranes. The skin surface is immune.

The persistence of genito-urinary gonococcic infection, often in the absence of subjective symptoms, explains many cases of contagion the source of which is occult. In women latent foci of infection become more active during the menstrual epoch, hence the chance of transmitting the disease is greater at this time. After months or years of scatheless cohabitation with such a carrier, gonorrhea may finally be transmitted, even though the donor has not been obviously reinfected.

In the male these latent foci are found in the urethra, its glands, ducts, and follicles, the ducts of Cowper's glands, the prostatic ducts, the ampulla of the vas, and the seminal vesicles, probably also in the epididymis. In the female the seats of chronic and latent infection are in the cervical canal, the urethra, and the ducts of Bartholin.

An attack of gonorrhea does not immunize against recurrence of the infection. The first attack is, however, likely to be the most severe, in so far as local manifestations are concerned, but not in regard to the disseminated expressions of bacteremia (gonorrheal rheumatism).

A gonococcic infection has a general tendency toward spontaneous recovery, not only in so far as its obvious clinical manifestations are concerned, but also in regard to the complete destruction of the infecting agent. The results of the inflammation excited by it are often permanent, as instanced in the formation of stricture, the occlusion of ducts, and the ankylosis of joints, the tendency of the reaction excited by it being formative and ultimately cicatricial rather than suppurative.

The treatment of gonorrhea is necessarily based upon the vulnerability of the infecting organism, its method of invasion, and the resistance which may be expected from the tissues of the areas involved. Since bacteremia, as expressed in the form of gonorrheal rheumatism, is secondary to the local invasion and dependent thereon, even treatment for manifestations of this condition is in the main dependent upon the cure of local lesions.

If gonococcic pus be placed upon the healthy urethral mucosa, it may be washed away by the first act of urination. A contact of at least some hours is needful for sufficient penetration into the epithelial layers to render mechanical removal impossible. This prolonged contact is insured by entrance of contagious pus into the urethral ducts and follicles, where it is no longer subject to the flushing effect of urination. Moreover, favoring conditions for infection are usually furnished by the local congestion incident to violent prolonged coitus and to the effect of urine made unduly irritating by alcoholic excess.

As long as the gonococci are superficially placed upon the mucous surface they can be reached directly by antiseptics, and, since they are comparatively vulnerable to non-irritating organic silver salts, their destruction by such solutions is practicable. Where, however, the germ growth has penetrated to the deeper epithelium and the sub-epithelial connective tissue, and has invaded the ducts and follicles opening into the urethra, antiseptics are in themselves of little service. The applications made under these circumstances have for their objects cleansing of the mucous surfaces, the lessening of edematous swelling, hence providing for better drainage of the involved urethral ducts, and the excitation of a local hyperemia of such degree as will increase cellular resistance, thus aiding in the limitation and destruction of the invading organism.

Hence, it is not needful that the lotion selected should possess high bactericidal powers. It is, however, absolutely essential that it should not be intensely irritating, that the practitioner employing it should be thoroughly familiar with the usual effect of a given strength upon the

average patient, and that he make an individual study of the strength appropriate to each individual.

When the inflammation is hyperacute from its beginning, a further augmentation of tissue reaction is contraindicated. When the symptoms are subacute the remedy employed should be of such strength as to produce a reaction, characterized by a scanty serous exudate with fairly prompt (one or two days) lessening of the quantity of purulent discharge.

An injection wisely chosen and administered causes little or no pain, either at the time of application or afterward. The injections of choice are protargol, ammonium sulphichthyolate, potassium permanganate. Dobell's solution, zinc and lead salts, and silver nitrate are useful in chronic conditions.

Not only must the strength of the injection be gauged in accordance with the condition present, but it must be so given that the meatus is not vulnerated and the urethra is not distended beyond the limit of tolerance.

The general principles obtaining in regard to the strength of injection, strength being estimated in regard to the irritating effect exerted on the urethral mucosa and the intensity of urethral inflammation present, are applicable to medicaments given by the mouth. These have for their immediate end the conversion of the urine into a lotion, which not only mechanically washes the urethra at each act of urination, but which produces either a non-irritating or, in subacute cases, a stimulating effect upon the urethral mucosa. The rendering of the urine antiseptic is of minor importance. Sandalwood oil, and particularly its ester, santyl, is most serviceable in this regard. Salol and urotropin are also helpful.

In hyperacute cases a further stimulation on the part of the urine is most undesirable, hence every effort is made to keep this excretion unirritating, and, indeed, this is an essential part of the treatment of all inflammatory conditions of the urethral tract. This implies as perfect a condition of digestion as is obtainable; the ingestion of as much water as may be taken without interfering with stomach digestion; moderation in eating as to quantity; the avoidance of such articles as are known occasionally or habitually to disagree; regular and adequate bowel movements, and the avoidance of surface chill or bodily fatigue.

As causes which most frequently result in marked aggravation of an acute condition (aside from injudicious injection, instrumentation or medication, sexual excitement, and violent exercise), the ingestion of alcohol, constipation, and surface chilling are the most frequently operative. Oxaluria, phosphaturia, excess of uric acid, these conditions must be corrected by appropriate medication and dietetic treatment.

GONOCOCCIC URETHRITIS

Prophylaxis.—The prophylactic treatment of gonococcic infection is theoretically simple. Except in the case of infants and children it is practically always contracted during sexual intercourse, and in men by

implantation upon the first inch of the urethra. The rarity of bacterial gonorrheal conjunctivitis in the adult shows that in them this membrane is comparatively immune.

Less than 1 per cent. of men suffering from gonorrhea have contracted it in ways other than from an illegitimate intercourse. Hence the method of general prophylaxis is obvious. Practically all prostitutes are at least potential carriers of infection.

A small percentage of women develop the disease incident to marriage with latent carriers, and thereafter, even though their husbands be definitely cured, may reinfect them. The wearing of a condom during intercourse is, under such circumstances, advisable. This precaution should be taken, as a rule, for some months after marriage by all men who still exhibit at the time of their wedding pus shreds, even though repeated examinations of these and of prostatic expressage, of seminal emissions, and of urethral discharge aggravated by instrumentation, show absence of gonococci.

Abortive Treatment.—The gonococcus placed upon a vulnerable mucosa remains entirely superficial, and hence accessible to the action of germicides, always for hours, at times for days. During this period the disease can be aborted by the thorough application of an efficient germicide. The sooner this application is made after the gonococcal deposit the more certain are its curative results. The silver salts of choice are those which are bactericidal without being irritating. Protargol, 5 per cent. solution, freshly put up, dropped over the meatus and frenum and into the opened lips of the meatus, will destroy all gonococci with which it comes into contact. Since, however, infection may occur in the periurethral crypts or follicles, or pus containing gonococci may exceptionally be carried almost at once into the ducts of the urethral glands, this preventive treatment is not always efficient. That it may be made so in urethral infection is attested by the uniformly favorable results of a similar method of treatment, as applied to the infant conjunctiva infected from the genital canal of the mother during parturition.

If the patient presents himself within three or four days of exposure, exhibiting a scanty, thin gray discharge, made up of flat epithelium and a little pus and mucus, an abortive treatment may still be successful. The gonococci as yet may not have penetrated beyond the outer epithelial layers, nor have invaded the urethral ducts so deeply as to be beyond reach. By the employment of an antiseptic and an irritant the surface gonococci are destroyed, and those still comparatively superficial are thrown off by a rapid desquamation. Protargol is again the solution of choice. The meatus is held open, and a 5 per cent. protargol solution is trickled into it. Thereafter, by means of a blunt-nozzled syringe, which fits comfortably into the meatus, the first three inches of the urethra, limited by finger pressure on the urethral floor, are gently dilated with the protargol solution. The syringe is withdrawn and the lips of the meatus are held together ten minutes. This injection is repeated at such intervals and in such strength as will be indicated by

the local symptoms, usually at intervals of two to four hours. The proper reaction is that evidenced by a scanty serous discharge, unattended by either the pain or swelling of a hyperacute inflammation. If the abortive treatment be successful, the strength of the injection can be gradually weakened to a 1 per cent. solution in three days, and two days thereafter can be omitted entirely, providing there be found no gonococci in the scanty discharge which may persist for a week.

If the patient presents himself with a frankly purulent discharge, abortive treatment is no longer practicable.

General Treatment.—Under the discussion of the general principles governing the treatment of gonorrhea have been indicated those measures which tend to make and keep the urine bland and to lessen pelvic and hence urethral congestion. As to the ingestion of water, two to three quarts a day should be taken, providing this quantity does not interfere with gastric digestion. The diet should be simple, nutritious, adequate, and should exclude desserts, alcohol, occasionally coffee, and highly seasoned articles. The overfed can advantageously be put upon an extremely low diet—buttermilk and milk—providing there be no idiosyncrasy against them, serving well. In hyperacid conditions, especially when associated with scanty secretion, potassium citrate and potassium acetate are useful drugs. Each should be given widely diluted, and in doses according to the effect desired, usually 10 gr. three to six times a day. Usually the initial inflammation is too acute to admit of the immediate administration of the balsams. When, however, from the first the local symptoms are subacute, and, as a rule, when they have so become incident to judicious treatment, santyl in capsules, 7 minims six to ten times a day, followed immediately by a glass of water, is an efficient remedy. If it produces stomach irritation it must be stopped at once, since there is no drug with a local beneficial effect sufficiently marked even remotely to compensate for the ill effects of gastric or intestinal indigestion. Sandalwood oil is less readily tolerated, and the same may be said of copaiba.

Local Treatment.—Whether injection or irrigation be the choice, whichever method be employed, a great part of the prompt success following it is dependent on the gentleness with which it is applied. Whenever the inflammation has penetrated to the posterior urethra the lotions, if applicable at all, should be made to the entire canal.

Before making the injection the urethra is first gently massaged from behind forward, for the purpose of emptying its glands and follicles, and is cleansed by the act of micturition. Thereafter, by means of a blunt-nozzle syringe, which will hold at least ½ ounce, the meatus and its opened lips are washed with a few drops of the fluid of choice. The nozzle of the syringe is then inserted within the meatus, and the injection is slowly introduced until the anterior urethra is moderately distended. By pressing the lips of the meatus together the moment the syringe is removed the injection may be retained in the urethra for as many minutes as may be desired. The injection should produce no pain other than that of distention, should not be followed by stinging

or burning, nor, in acute conditions, should it immediately stop the discharge. These results indicate that it is too irritating and imply either change or weakening. If of proper strength there should, in the course of one to three days, be a marked diminution of the quantity of discharge and the severity of the inflammatory reaction. When this condition is attained the strength of the solution may be cautiously increased, to be gradually diminished with the disappearance of the gonococci.

The usually accompanying posterior urethritis, as evidenced by perineal pain and frequent urgent urination, at times only by pus in the second portion of the urine passed, is not reached by anterior injection driven in by a piston syringe, nor is it desirable that it should be. In the injection treatment of acute gonorrheal total urethritis, after urination and injection, the eye of a soft catheter is carried within the grip of the urethral sphincter and 2 to 4 drams of the solution of choice are slowly driven in.

As a rule, in the ordinary case of acute gonorrheal urethritis injection should be repeated night and morning. The retention of the anterior injection by finger or instrumental pressure for from ten to thirty minutes is a harmless complication of treatment which at least secures bodily quietude on the part of the patient for that period. A retention for one or two minutes with gentle massage of the urethra is desirable.

Hyperacute posterior urethritis, characterized by urgent, painful, and frequent micturition or even by complete urinary retention, is best treated by diluents, hot sitz-baths, and morphin and atropin injections. Total irrigations of hot ammonium sulphichthyolate solution, 1:8000, or Dobell's solution one-half strength are indicated if they can be given without exciting severe pain, and if they are followed by increased comfort. In case sphincterismus be so violent as to make this procedure impracticable, injections may be employed of similar solutions through a catheter, the eye of which is passed just within the grip of the compressor urethræ muscle. This treatment is contraindicated if it is extremely painful, and particularly if it aggravates the inflammatory symptoms.

If there be urinary retention, continuous catheterization is advisable, supplemented twice daily by irrigation of the posterior urethra, accomplished by drawing the eye of the catheter out until it lies just within the grip of the compressor urethræ muscle and allowing 3 or 4 ounces of the solution above named to pass through the prostatic urethra into the bladder. There is usually an accompanying prostatitis as indicated by rectal examination.

The irrigation treatment is conducted by means of a fountain syringe which will hold at least a pint of fluid, with a conical nozzle of such shape as to fit into the meatus comfortably and tightly. The advantage it possesses over injection is that it produces a more even and prolonged stretching of the urethral mucosa, therefore better penetration into the glands, the ducts, and follicles, accomplishes a more thorough cleansing of the mucous surface, and by its use the posterior urethra is more readily

reached and thoroughly washed. The solutions of choice in irrigating treatment are potassium permanganate, beginning with the strength of 1:8000, and running to a strength not greater than 1:2000, and ammonium sulphichthylate, 1:4000, and not employing a solution stronger than 1:500. Silver solution may also be used, particularly protargol. Irrigations are repeated night and morning, the strength of the solution being so regulated as to produce no undue inflammatory reaction.

The subsiding stage of the infection is characterized by a scanty mucopurulent discharge, containing much epithelium, a few gonococci; astringent injections are serviceable.

The strength of this injection must be altered in accordance with local conditions. If it produces a marked lessening of the discharge, without exciting pain at the time of injection or inflammatory symptoms thereafter, it is the proper strength. If it fails to influence discharge and produces no reaction, it should be strengthened.

Folliculitis and adenitis, characterized by nodulations along the course of the urethra, commonest near the meatus, are best treated by non-irritating hot irrigations and swathing the penis in gauze wet in 5 per cent. ichthyol solution. Moisture is retained and the clothes protected by an oiled silk or gutta-percha tissue covering over the gauze dressing. Even if pus forms it usually empties into the urethra. When complicated by a suppurative periadenitis with demonstrable fluctuation, evacuation of pus by an external incision is indicated. Should fistula result it is usually cured by bringing the urethra to full caliber. Exceptionally a plastic is required.

Cowperitis.—Characterized by the intense pain, retention of urine, and the detection of induration to one side of the midline anterior to the prostate, cowperitis usually subsides under the treatment appropriate for folliculitis or prostatitis. In case it persists, and particularly when pronounced symptoms of general sepsis are associated with those of deep perineal inflammation, incision and excision of the gland are indicated.

Prostatitis, characterized by urgent, frequent, painful urination, constitutional symptoms of sepsis, and the detection of a tender swollen prostate by rectal examination, is usually relieved by hot sitz-baths and hot rectal irrigation of normal salt solution through a two-way catheter. At times cold rectal irrigation is more soothing than hot. For the harassing pain and tenesmus morphin should be given hypodermically, preferably combined with small doses of atropin.

The associated acute posterior urethritis may be treated by total or catheter irrigation with hot ammonium sulphichthyolate, 1:8000, or Dobell's solution one-half strength. Irritating injections or irrigations are contraindicated. Indeed, it is usually advised that all local urethral treatment should be stopped during the acute course of any of the complications of urethritis. A sedative and cleansing urethral treatment is, however, distinctly indicated, providing it can be given without causing undue pain and providing it adds to the patient's comfort.

If the symptoms of sepsis are severe and progressive, the prostate

should be exposed by the perineal incision employed in prostatectomy, and the abscess or abscesses contained within it should be opened and drained. If, as is sometimes the case, there are multiple abscesses throughout its whole substance, the prostate should be removed. This rarely will be required, as a free splitting of one or both lateral lobes will usually provide drainage sufficient to relieve tension.

Vasitis and Vesiculitis.—These complications, during their acute stages, can be distinguished one from the other not at all, and from prostatitis often with some difficulty.

The treatment is the same as for prostatitis. If abscess forms toward the rectum, incision can be made in this direction. If, from the persistence and aggravation of local symptoms and the progressive severity of sepsis, it is evident that there is pus under tension, perineal opening is indicated. This is rarely required.

Trigonitis Ureteritis Pyelonephritis.—It is probable that the trigone is involved to an extent in all acute cases of posterior ureteritis. Exceptionally, the infection extends along the ureters to the renal pelvis and the kidney. The treatment, aside from that appropriate to the urethritis, is not different from that indicated in pyelonephritis due to other forms of infection.

Epididymitis, characterized by pain, tenderness, and swelling, differs from that incident to other than gonococcic infection from the fact that it is usually not grossly suppurative in type, but exhibits a characteristic tendency toward fibrosis.

Elevation of the parts, and immediate cessation of all urethral treatment, or the substitution of a sedative for a stimulating one, are indicated. In cases of moderate severity, support of the testicle by means of a sweating suspensory bandage, and the local applications of ichthyol ointment, 20 per cent., are efficient. In severer cases the patient is confined to his bed, the testicles are held up by means of an adhesive strip, passed beneath the scrotum from one thigh to the other, by a handkerchief bandage secured to a waist band, and are swathed in gauze kept wet with a 5 per cent. ichthyol solution, or dilute lead water and alcohol equal parts, no provision being made against evaporation; if the pain be exhausting, morphin is given hypodermically. A saturated solution of magnesium sulphate may be used as a local application or a 10 per cent. guaiacol ointment.

In individual cases relief is afforded by heat—hot sitz-baths or, better, hot general baths—followed by placing a thin-walled half empty hot-water bag beneath the scrotum, interposing between the rubber and the skin four layers of gauze, wet in the lotion of choice. Cold is at times more soothing, the bag then being filled with cracked ice. The choice of heat or cold must be in accordance with the sensations of the patient. If, in spite of conservative treatment, symptoms of the local and constitutional infection are progressive, free incision and drainage are indicated.

CHRONIC URETHRITIS

When gonorrheal urethritis, which has been carefully treated, persists for more than twelve weeks, in the form of a free purulent discharge, a morning drop with marked increase of discharge from trifling causes, or pus in the urine, without obvious discharge, the condition may be regarded as chronic. Inflammatory foci may be either in the anterior or posterior urethra; they are usually in both. Discharge from the meatus necessarily indicates involvement of the anterior urethra. Pus in the second portion of the urine passed from a full bladder shows posterior involvement. Sudden increment of discharge, with inflammatory symptoms incident to trifling causes, followed by rapid subsidence, are characteristic of the forward extension of inflammation from the posterior urethra.

If a patient presenting a persistent discharge is under active treatment the effect of this treatment should first be determined by stopping for several days all local applications, due attention being paid to diet, hygiene, and rendering the urine bland. Moderate exercise is desirable, except during acute exacerbations, nor, save in the grossly overfed, need any easily digested foods be forbidden which usually agree with the individual patient. He is rather directed to lead his ordinary life and forget his urethritis in so far as this is possible.

Not infrequently a discharge of months' or even years' standing when thus neglected stops promptly and permanently, from which the inference is plain that chronic urethritis is at times kept up by treatment.

If, on cessation of treatment, the local symptoms of inflammation persist, but without aggravation, for one or two weeks, the internal administration of balsams is indicated for a brief period, santol and copaiba representing the best preparations. If there is no prompt betterment, local examination and treatment are called for.

If, during the watching period, the symptoms of urethral inflammation become more pronounced, it is obvious that these have been favorably influenced by treatment, and that a continuance of this, with appropriate modifications, is indicated.

Local examination, called for when a chronic discharge is either uninfluenced or is aggravated by stopping local treatment, has for its end the determination of the seat and the nature of the inflammation.

The patient should present himself with a full bladder. The anterior urethra is gently milked forward, and, if discharge be obtained, it is examined for pus and gonococci. The patient passes about two-thirds of his bladder contents in two glasses—pus in the second will indicate posterior urethritis. The prostate, seminal vesicles, and vasal ampullæ are massaged toward the prostatic urethra. The patient then empties his bladder; a marked increase in the quantity of pus found in this last portion, as contrasted with that found in the second urine passed, indicates that it must have been expressed into the urethra from the prostatic or the ejaculatory ducts. The pus found in these specimens of urine is examined for gonococci.

The anterior urethra first, then the entire urethra, is flushed with a mild antiseptic solution, protargol, 1:8000, and, if the patient be hypersensitive, is anesthetized by instilling along its course a 10 per cent. solution of eucain lactate.

By means of a dilating urethrometer the caliber of the anterior urethra is determined, and points of narrowing and of especial tenderness are recorded. The anterior urethra is then inspected through a urethroscope of as large size as the meatus will admit, is again flushed with protargol, and a sound as large as the meatus will admit is passed into the bladder. This is followed by a total irrigation.

When gonococci are present in the discharge, and this is usual in the acutely or subacutely recurring cases, there is a general belief that antiseptics are indicated, astringents being reserved for cases from which the specific infection has disappeared. If this be a rule of treatment, it should be one to which exception often should be made. Local treatment has for its end the excitation of an acute reparative hyperemia. If too acute, cellular resistance is diminished and symptoms are aggravated; if not sufficiently acute, the chronic inflammatory process and its infiltration are uninfluenced. The drug which in the given individual produces the proper degree of reaction is the one of choice. Those already mentioned, but in greater strength, are usually efficient; to them may be added silver nitrate in certain cases refractory to less irritating applications.

Before the chronic urethral discharge can be stopped, stricture, if present, must be cured by cutting to two sizes beyond normal caliber in the penile urethra, usually by intermittent dilatation if placed further back; papillomatous growths must be removed, preferably by the cautery knife or loop; exceptionally, keratosed patches must be treated directly through the urethroscope by applications of tincture of iodin, carbolic acid, or the solid stick of silver nitrate, and suppurating follicles and gland ducts must be slit up and cauterized.

The treatment usually successful in the absence of stricture is by injections, irrigations, instillations, and a regimen calculated to bring the patient to the highest degree of health, and to make the urine either entirely bland or somewhat stimulating.

If the inflammation involve both anterior and posterior urethras, a total irrigation once a day is indicated, beginning with a mild solution, and gradually increasing its strength, but stopping short of producing undue inflammatory phenomena. This irrigation is supplemented by one or two daily injections at night.

The irrigation, given through a short urethral nozzle, may begin with protargol, 1:4000, increasing day by day to 1:1000 or even 1:500 thereafter, if the symptoms are bettered, being gradually weakened, then discontinued. Frequent urgent painful urination, lasting for more than a few hours after treatment, indicate that the solution is too strong. If protargol prove too irritating, ammonium sulphichthylate, beginning with 1:4000, or potassium permanganate, in the same strength, may be used.

The injection may be of protargol, 1:500 to 1:100. The two formulas which are most likely to prove serviceable are the following:

℞ Zinci sulphatis.....gr. xx–xl;
Plumbi subacetati.....gr. xv–xxx;
Aquæ camphoræ.....℥ij;
Aquæ destillatæ.....q. s. ℥vj.
Sig.—Locally.

℞ Bismuthi subnitratis.....℥vj;
Extracti hydrastis fluidi (alules).....℥vj;
Mucilaginis acaciæ.....℥ij;
Aquæ destillatæ.....q. s. ℥vj.

Instillations, particularly indicated when the seat of major involvement is in the posterior urethra, may be given by the instillator or through a soft small-caliber catheter. Protargol, 5 per cent.; argyrol, 10 per cent.; silver nitrate, 1 to 5 per cent., are the solutions of choice. These instillations should follow the irrigations, and are repeated every one, two, or three days, in accordance with the degree of inflammatory reaction excited by them.

If there be follicular prostatitis, or a vasitis or vesiculitis associated with the chronic posterior urethritis, every second or third day, before irrigating, a vesicular and prostatic massage is practised.

In cases uncomplicated by stricture, the short nozzle irrigation, with a four-foot elevation of the bag containing the solution of choice, gives a more gentle and uniform dilatation of the urethra than can be accomplished by any instrument.

When the urethral gland ducts and follicles are markedly invaded, the passage of a full-sized sound, after preliminary irrigation and gentle massage of the urethra upon this, is desirable; it should be followed immediately by a second anterior irrigation. A similar result may be attained by passing the urethrameter to the compressor urethræ muscle, opening it short of the production of marked pain, and withdrawing it with a swabbing motion, regulating its size as it is pulled forward in accordance with the normal caliber variations of the urethra.

A meatus below 22° F. will usually require cutting before cure of a chronic urethritis can be accomplished.

SYSTEMIC INFECTION

Nearly all cases of acute gonorrheal urethritis are accompanied by moderate fever and slight evidences of toxic absorption, which become pronounced if the posterior urethra is markedly invaded and still more so on the advent of complications implying exudate under tension, such as prostatitis or epididymitis. Local manifestations of bacteremia usually involve the joints, though the meninges, the endocardium, and other tissues may be affected.

Joint involvement, rare in the first week, common in the third and thereafter (months or even years), beginning in either the synovia or the epiphysis, affords no symptomatology characteristic of gonococcic bacteremia, and is recognized as due to this cause because of the finding of an associated focus of gonococcic infection, usually in the posterior urethra or the glands or ducts leading therein.

Whether the joint condition be acute or chronic, the promptest and most permanent relief is given by finding and curing the primary focus of infection.

Joint involvement may be manifested by slight swelling and tenderness, by a rapidly formed and pronounced fluctuating swelling due to serous effusion, by a comparatively slow brawny tender, usually painful and persistent swelling, or by a rapid edematous swelling accompanied by constitutional symptoms of profound sepsis.

Aside from the urethral treatment, which in acute cases must be sedative, the joints characterized by the rapid development of a fluctuating swelling, without great pain or marked constitutional symptoms are treated by splinting in the most comfortable position, and by swathing, the part in gauze wrung out from a 10 per cent. ichthyol solution. Over this gauze is applied a hot-water bag. If cold be more agreeable to the patient, the rubber bag is filled with ice. With the subsiding intensity of the urethritis or its complications, the manifestations of arthritis disappear, often with astonishing rapidity. If the effusion persists, if it is exceedingly painful, or if the joint becomes so greatly distended that the integrity of its ligamentous support is threatened, puncture or incision of the joint is indicated. Recurring reaccumulations of fluid call for flushing out the joint with dilute bichlorid (1 : 10,000) or weak carbolic (1 : 500) solution, the part being splinted for at least two weeks thereafter.

Brawny, intensely painful joints, with moderate joint effusion, are treated by splinting the part in the position of greatest usefulness in case of ankylosis, the application of heat or cold in accordance with the comfort derived therefrom by the patient, and morphin in sufficient doses to control pain. These cases are persistent, usually end in ankylosis, and are little benefited by operative or other form of treatment aside from that directed to the original focus of infection.

When the local and constitutional symptoms indicate a mixed acute infection of the joint and rapid progressive pus formation, free incision and drainage are indicated, at times excision or amputation.

For the various joint expressions of bacteremia serums and vaccines have their enthusiastic advocates. If it be remembered that these cases are, without treatment, subject to sudden exacerbations and remissions, a study of published reports fails to convince as to the usual cure of a gonococcic joint infection by such means. As to the choice of one or the other, the vaccine seems to have given best results. It should be made in each case, when practicable, from the patient's discharge, and should be given in moderate doses in acute cases, in larger doses in chronic ones, so gauging the number of dead gonococci administered that the febrile reaction is absent, or at the most moderate, allowing a sufficient interval for reaction, and continuing with the treatment only if the patient's local lesions are bettered and his general condition not made worse.

From 50,000,000 to 200,000,000 repeated at intervals of a few days, may be regarded as an average dose in chronic cases. The general condition of the patient following injection is a better guide as to dosage and repetition than an observation of the opsonic index.

Gonococcic Infection in the Female.—The preventive treatment, after exposure to contagion, lies in copious vulvar and vaginal douching with protargol solution, 1 per cent. The urethral orifice should be held open, and against it and the openings of the urethral glands a forcible stream should be injected.

For the urethritis of the adult, usually the first manifestation of infection, twice daily there should be given an injection of protargol, 1 to 5 per cent., depending upon the degree of inflammatory reaction excited. This may be applied by a conical-nozzled piston syringe, or if there be frequent, urgent, and painful urination, weaker solutions may be injected into the bladder by either the syringe or irrigator. The inflamed gland ducts at the urethral orifice may be injected with 5 to 10 per cent. protargol solution, driven in by a blunted hypodermic needle. If the glands become acutely inflamed and suppurating, they are opened freely through the ducts and cauterized with pure carbolic acid.

Inflammation of Bartholin's glands, if either hyperacute or chronic, and recurringly subacute or persistent, is treated by excision.

Vaginitis and vulvitis, comparatively rare except in children and young girls, are treated by copious douching, at first with bland solutions —normal salt solution, boric acid, a dram to the pint, ichthyol, 1:8000; thereafter by the organic silver salts, protargol, 1:2000 to 500. The douchings are repeated in accordance with the requirements of cleanliness.

Gonococcic infection of infants and children, usually expressed as a vulvovaginitis, without involvement of either the urethral or cervical mucous membrane, is treated in its acute stage by irrigations of weak peroxid of hydrogen solution, protargol, 1:2000, or potassium permanganate, introduced by means of a soft catheter passed well within the vagina. The irrigations are repeated in accordance with the requirements of local cleanliness. The profuse mucopurulent discharge gives place to a scanty mucous one, which may persist for years and still contain gonococci.

The strongest evidence in regard to the therapeutic value of vaccines has been adduced by Hamilton, who has treated both acute and chronic cases of vulvovaginitis in children by injections, beginning with 50,000,000 dead gonococci, and repeating every fifth day, 10,000,000 being added to the dose with each repetition. There was neither local nor general reaction, and cure, as corroborated by repeated careful examinations, was accomplished usually in six treatments. When one strain of vaccine proves inefficacious he advises the employment of another.

Endocervicitis is indirectly benefited by copious hot vaginal douching with ichthyol solution, 1:4000, mercuric chlorid, 1:16,000 to 8000, or hydrogen peroxid, 40 per cent. solution 1:10, such douching being repeated once or twice daily in accordance with the quantity of discharge and the sense of relief given by the treatment. Direct applications of iodin and carbolic acid, strong silver nitrate solution, or other cauterants, antiseptics, and astringents, even though preceded by curetment, have little curative effect. Linear cauterization (actual cautery) has been helpful in some cases resistant to all forms of treatment. Amputation of the cervix may be necessitated by the conditions resultant from long-continued inflammation.

VACCINIA

By Jay F. Schamberg, M. D.

Vaccinia is a disease communicated by inoculation for the purpose of protecting against small-pox. Before the introduction of vaccination by Jenner, in 1798, the custom prevailed in many countries of inoculating the virus of small-pox with the object of producing a mild and attenuated form of the disease, and insuring protection against a natural attack of small-pox which was feared on account of its almost universal prevalence and its fatality. Vaccination, or the insertion of the virus of cow-pox, has two great advantages over "inoculation"—it is safer and it gives rise to a benign and non-contagious disease; the degree of protection conferred by vaccination is almost equal to that granted by inoculation of small-pox.

It has taken almost a century of experimentation to prove the truth of the statement made by Jenner in his first publication that small-pox and cow-pox were modifications of the same disease. Whether small-pox is a cow-pox of exalted virulence or cow-pox an attenuated small-pox, remains undetermined. Numerous experiments have proved that it is possible to transform the virus of small-pox into that of cow-pox by variolation of the bovine species and the transmission of the affection through several generations of calves. Many strains of excellent vaccine virus employed at the present day have been derived from such a source.

While the evolution of the vaccine lesion is a more or less constant one, yet a certain degree of variation will result according as the vaccination is performed with original long-humanized cow-pox virus or heifer-transmitted virus. These differences refer rather to the comparative rapidity of the process, the size of the lesion, and the character of the resulting scar, than to any deviation in the evolution of the pock.

On the third or fourth day after the insertion of the virus a faint redness may be seen at the site of the vaccination. This gradually increases, and a papule is formed which becomes vesicular about the fifth day. The vesicle increases in size, the contents being at first serous and later lactescent. On the eighth day the vesicle reaches its greatest perfection and acquires a reddish areola. The axillary glands become enlarged and tender; mild constitutional disturbances develop on the ninth or tenth day. On the eleventh or twelfth day the pock begins to undergo involution and by the end of the third or fourth week the crust is thrown off.

The Hygiene of Vaccination

In order that a vaccination may pursue a perfect course and remain free of subsequent complications, it is important that certain precautions be observed. These may be classified as follows: Care as to (1) purity of the vaccine virus; (2) condition of the vaccinée; (3) asepsis during insertion of the virus; (4) subsequent protection of the vaccine lesion.

Purity of the Vaccine Virus.—Vaccine virus may be of human or bovine origin. Within recent years the use of calf-lymph has become generally and, indeed, almost universally adopted. The German Government in 1884 passed a law that vaccination and revaccination in the Empire of Germany be performed exclusively with animal virus. In Mexico humanized lymph is still extensively employed, and is preferred by the physicians of that country to bovine virus.

Humanized Virus.—In cases where it is necessary, by reason of vaccine famine or deterioration of virus, to employ humanized lymph, it is best taken from a vaccine pock from the fifth to the eighth day. Virus should only be used from a perfect, primary, vaccine vesicle containing clear or opalescent fluid. Where there is excessive inflammation or any other irregularity present, the vaccinifer should be rejected. The employment of the contents of lesions which have become purulent is strongly to be condemned. Jenner's dictum was that lymph should never be taken from a lesion after the formation of the areola; this he regarded as the "golden rule of vaccination." The vaccine crust is inferior to direct arm-to-arm vaccination with fluid lymph. When a crust is employed at the present day it should be moistened with boiled water and rubbed upon with a sterile piece of glass.

The condition of health of the vaccinifer is of the greatest importance. When humanized virus is employed, careful inquiry as to the health of the parental antecedents should be made. The subject from which the vaccine is obtained should be in thoroughly good health. The greatest care should be taken to determine that the vaccinifer is free of hereditary syphilis. While the transmission of this disease by vaccination is extremely rare, its possibility is sufficiently well established to warrant every precaution being taken.

It is the custom to obtain vaccine virus only from young subjects; these are, of course, less apt to be suffering from certain transmissible diseases. It is well, however, that the infant vaccinifer should have reached the age of six months or thereabouts, so as to have passed the period at which evidences of hereditary syphilis usually make their appearance.

To obtain human vaccine-lymph the vesicle, after having been previously cleansed with soap and boiled water, should be punctured in several places with a lancet and the droplets of lymph allowed to flow out. These are then transferred upon a clean lancet to the individual about to be vaccinated; or if the lymph is to be used later or employed upon some one at a distance, it may be collected in a sterile capillary

tube. After the vesicle is punctured the tube is thrust through the opening, the lymph filling the tube by capillary attraction. When it is about two-thirds full the tube is withdrawn and the ends sealed by heating them in a Bunsen flame. The tubes should be kept in a cool place until used. To expel the lymph from the tube the ends should be broken off and the fluid blown out with a small rubber bulb.

At the present day we are chiefly concerned with *bovine-lymph*. This material is employed in two different forms—as a lymph and as a vesicle pulp. Lymph, which is the clear fluid contents of well-developed vaccine vesicles, has been in use a long time. Pulp, which is a combination of the lymph and the interior epithelial structure of the pock, has more recently come into favor, and is at the present time regarded as possessing greater vaccinal activity than the clear fluid. Vaccine-lymph is used either in the dry form upon strips of ivory or celluloid (so-called "dry points") or in sealed capillary tubes in the form of a glycerin emulsion.

There is a growing sentiment among the best observers in favor of the use of glycerinated lymph. This form of lymph has the sanction and endorsement of the British Royal Vaccination Commission. The method of preparation of dry and glycerinated lymph is elsewhere considered.

Condition of the Vaccinée.—There is nothing in the condition of a child that constitutes a sufficient contraindication to the performance of vaccination if there is liability to the infection of small-pox. In the Municipal Hospital of Philadelphia, during the presence on the grounds of small-pox cases, scores of children suffering from scarlet fever and diphtheria were vaccinated. While the vesicles were not always perfectly developed, no untoward results were observed from vaccinating these patients.

When small-pox is not prevalent, it is proper for physicians to exercise discretion in choosing the time for the vaccination of an infant. There being no urgency, the medical adviser may wait until the child has reached a favorable age and is in good condition for the reception of the vaccine disease.

Age of the Child.—In order that proper protection against small-pox may be granted to infants, it is advisable that they should be vaccinated during the first year of life. The vaccination laws of Germany require that every child be subjected to this measure before the expiration of the first year of life, unless it is contraindicated by reason of poor health. The age which is generally considered most appropriate is between *four and six months*, for at this period the child has not yet begun to be disturbed by the process of dentition. If there be danger of small-pox, there is no reason to delay because of the tender age of the child. On a number of occasions I have observed infants vaccinated immediately upon their entrance into the world, and I can recall no bad effects from such early vaccination. Indeed, I have been impressed with the very slight degree of constitutional disturbance that has attended such vaccinations. Where, however, no haste is necessary, it is well to wait

for several months until the child becomes stronger and more accustomed to its mundane environment.

Health of the Child.—It is best to delay the performance of vaccination (provided small-pox be not prevalent) if the child is poorly nourished, suffering from diarrhea, vomiting, tuberculous glands, eczema, etc., or if the infant has been recently weaned or placed upon some new food. Vaccination of such children is prohibited by the regulations of the English Local Government Board. Vaccination of a child suffering from a moist eczema may lead to multiple inoculations through transference of the virus. In general terms it may be said that when small-pox is not prevalent, the physician may select such time for the vaccination of an infant as may find it in the best physical condition.

Technic of Vaccination

Vaccination being in a sense a surgical procedure, its performance must be guarded by those precautions as to asepsis which at the present time apply to all chirurgic manipulations. Laboratory studies and practical experience have both shown that even in the most trivial of all surgical procedures—the introduction of a hypodermic needle into the skin—certain precautions as to bacterial cleanliness are necessary. Many years ago, before the days of bacteriology, this truth was not known, and consequently proper care was not, as a rule, observed either in surgery or in the practice of vaccination.

Asepsis.—It is, of course, desirable that the vaccine-lymph be free of foreign bacteria. In order that all wound infections may be avoided, it is advisable that the arm of the vaccinée, the instrument to be employed, and the hands of the vaccinator be perfectly clean. Furthermore, the vaccine vesicle must be so protected as to prevent subsequent infection at the site of vaccination.

Disinfection of the Skin.—Some difference of opinion exists as to the thoroughness with which disinfection of the proposed vaccination area should be carried out. Some writers urge such a preparation of the skin as is practised prior to an ordinary surgical operation. Others believe that the use of strong antiseptics is to be avoided, inasmuch as they may destroy the activity of the vaccine material when placed upon the skin.

It is advisable for the patient to take a tub-bath on or before the day on which the vaccination is to be performed and to put on clean undergarments. (Unfortunately, it is difficult to have these measures carried out in the very people who most need them.)

The vaccination area, usually the arm, is to be thoroughly washed with potash soap and hot water, some friction being used so as to distend the cutaneous capillaries. The arm is then to be dried with sterile absorbent cotton, or, when it is not available, with a perfectly clean towel. The operator may employ an ordinary lancet or a needle to produce the necessary abrasion. If the former is used, it should be previously disinfected by boiling, immersion in an antiseptic solution, or through

cleansing with soap and water or alcohol. It is perhaps better to employ a needle for the purpose, inasmuch as a new and clean one can be used for each vaccination.

The insertion of the deltoid muscle is the site usually selected for the introduction of the virus. The skin is made tense through the grasping of the inner side of the arm with the left hand. The epidermis is then abraded over an area of $\frac{1}{3}$ or $\frac{1}{2}$ inch; this is done either by vertical or cross scarification with a needle or simply scraping with a lancet or scalpel.

It is *important that the abrasion be not too deep.* The drawing of blood is to be avoided, inasmuch as it may float away the lymph and prevent absorption; it is further claimed that the deep scarification is more likely to be followed by an excessive degree of inflammation. It is not desirable to abrade deeper than is necessary to see the little reddish points which represent the loops of the papillary blood-vessels.

It is a matter of some importance to rub the virus well into the abraded surface. The hasty smearing of the lymph upon the arm with no further manipulation is probably responsible for a certain percentage of failures.

Some writers have advocated *vaccination by hypodermic or, rather, intradermic puncture.* This is accomplished by expelling the lymph upon the previously cleansed vaccination site, and then passing a thoroughly sterile hypodermic needle obliquely through the skin over this area. Several punctures should be made within an area of 1 cm. square, but they should not be deep enough to draw blood. The puncture carries the lymph into the skin. The alleged advantage that little or no scar results from this method appears to be in reality a disadvantage, for the presence of a scar and its character constitute, as a rule, visible evidence of the amount of protection against small-pox which the individual enjoys. There would appear to be, therefore, no special advantage of this over other methods of vaccination.

It is best to allow the lymph to dry upon the arm by exposure to the air; this will ordinarily take from ten to thirty minutes. Where it is inconvenient to keep the arm bared for this time, there is no objection to protecting the abraded surface for a few hours with a loosely fitting shield made of pressed linen. It is important that no shield should be applied which congests the parts by peripheral pressure or which exerts any suction.

The vaccine vesicle when formed should be sedulously guarded against mechanical violence or injury. Nature provides an excellent protective covering for the vaccine wound—a hard, concrete, firmly attached crust. This crust is formed by desiccation of the vaccine pock. When the vesicle is ruptured by traumatism, some of the contents escape and form an irregular, friable crust which is easily detached, leaving an open wound which is liable to infection with pathogenic organisms.

Shields.—Various forms of shields have been devised to protect the vaccine lesion from injury and infection. Many of these have failed

utterly of their purpose, and some have done actual injury by increasing the inflammation and by rubbing off the scabs and thus producing open sores. Some writers condemn all shields; those made of a light metal like aluminum, which protects the vaccine lesion from the adhesion of the sleeve and from accidental injury without exerting any injurious compression and which can be readily sterilized, may be recommended. The application of a sterile gauze compress over the vaccine vesicle is also advocated; there is no objection to this save where the vesicle becomes ruptured, when the crust will adhere to the gauze and be torn off with its removal.

Patients should be advised not to allow the sleeve of the shirt or undershirt to rub against the vaccine vesicle. It is often a good plan to have a thoroughly clean piece of linen sewed into that portion of the sleeve which comes in contact with the vesicle. Caution should be given patients against rubbing, scratching, or otherwise fingering the vaccination scab; manipulation of this character is a fertile source of ulceration and late wound infection.

Number of Insertions.—It is the custom abroad to insert the lymph at several sites. When this is done, the scarifications should not be too close, for fear of interfering with the vitality of the intervening skin, thus leading to sloughing. It is best to allow $\frac{3}{4}$ or 1 inch of healthy skin between lesions. In this country it is the custom to make but a single insertion.

When a person has been exposed to the infection of small-pox, it is well to insert lymph from two or three different tubes in different places, so that the fullest opportunity of inducing vaccinia may be offered. It is better that the patient should suffer from a sore arm than from small-pox.

VARIOLA

By Jay F. Schamberg, M. D.

Small-pox is an acute infectious disease due to the reception into the system, through the respiratory tract, of a *contagium vivum*, the identity and nature of which have not yet been determined. The disease is highly communicable, and is perhaps the most readily transmissible of all diseases. Almost the entire human family is susceptible to small-pox if protection is not secured by vaccination.

Before the days of vaccination, small-pox was one of the most prevalent and fatal of plagues and destroyed hundreds of thousands of lives each year.

That small-pox prevails in all parts of the world, from the frigid climes of Greenland to the torrid regions of Africa, is evidence of the fact that conditions of soil and climate exert but little influence upon the disease.

Season plays a considerable rôle in the prevalence of small-pox, the disease being essentially a cold-weather malady. Epidemics in Philadelphia increase in the Fall of the year, beginning with the month of October, and reach their maximum in the month of December or January, then decline month by month until July or August, when their minimal incidence is reached.

Small-pox is infectious in all of its stages, from the onset of the initial illness to complete decrustation. It is most transmissible during the eruptive stage and particularly during the period when particles of crusts are being thrown off from the skin.

The infection is usually conveyed by direct exposure, although the disease may be transmitted by infected objects or by healthy persons who have been in contact with patients. That the small-pox infection may be conveyed through the air from small-pox hospitals over considerable distances, to the extent of one mile or more, appears to be established by the experience of a number of such institutions.

Small-pox has an incubation period ordinarily of from ten to twelve days. At the end of this latent stage the initial illness develops, characterized by chill, headache, backache, nausea, vomiting, vertigo, high fever, and prostration. These symptoms abate wholly or in part on the third or fourth day, when the characteristic eruption of the disease appears. The eruption is at first macular or maculopapular, but gradually passes through the stages of vesiculation, pustulation, and incrustation, terminating with cicatrization and followed by pits or scars.

The temperature remits on the first to the third day of the eruption, but rises as the sixth day is reached, when the vesicles fill up with purulent material. This so-called secondary or suppurative fever varies in intensity and duration according to the number and depth of the cutaneous lesions. The number of lesions may in severe cases reach 40,000 or more. When the latter number is present, 6 or 8 quarts of pus are contained in the skin. Most patients who succumb to small-pox die from the ninth to the eleventh day of the eruption as a result of a streptococcus septicemia.

During the decline of the eruptive stage numerous boils and subcutaneous abscesses develop which cause an irregular fever and prolong the convalescence. The most common complications, apart from boils and abscesses, are variolous impetigo, erysipelas, secondary scarlatiniform erythema, cutaneous gangrene, otitis media, corneal ulceration, pleurisy, and cerebrospinal disorders.

The **prognosis** is chiefly influenced by the age of the patient and his vaccinal condition. The disease is extremely fatal in infants and in the aged. Alcoholism and the pregnant and puerperal state unfavorably influence the course of the disease.

The difference between the mortality of small-pox in the vaccinated and unvaccinated is most striking. Of 8650 cases treated in the Municipal Hospital of Philadelphia, under the charge of Dr. William M. Welch, 4964 were once vaccinated and 3687 were unvaccinated. The mortality in the former class was 12.53 per cent. and in the latter 41.82 per cent. Epidemics vary greatly in severity and the death-rate may at times be very low even among the unvaccinated.

The nature of the causative micro-organism is unknown. The most recent investigations suggest that the *causa causans* may possibly be an animal and not a vegetable organism. The causative agent is known to reside in the cutaneous lesions, for the disease may be produced by inoculation.

The treatment of small-pox may be considered in its relationship, first, to the patient himself, and, second, to the community at large. The latter aspect of the subject concerns the prophylaxis or preventive treatment of the disease. This may be conveniently classified under the following captions: Notification, isolation, surveillance or quarantine, disinfection, and vaccination.

Prophylaxis.—Notification.—It is important in the interests of public health that the existence of a case of small-pox should be promptly made known to the proper health authorities. It is usually the duty of the physician in attendance to transmit this intelligence. Every practitioner of medicine should feel himself called upon to aid and sustain the sanitary authorities in their efforts to prevent or stamp out a pestilential disease and should willingly comply with any arrangements whose object is the attainment of so desirable an end.

Most large communities have enacted laws making compulsory the notification of small-pox and other pestilential diseases, under pain of fine or imprisonment. It is only through a knowledge of the distribu-

tion and extent of small-pox in an infected district that the health authorities are enabled to intelligently and efficiently inaugurate measures toward its suppression.

Isolation.—It is of paramount importance, when small-pox appears in a community, to prevent the dissemination of infection; to this end the isolation of the patient—the source of the infection—becomes essential. This can only be accomplished with any degree of certainty by having the sick removed to a well-organized hospital. General hospitals and other public institutions cannot, with justice to the other patients and inmates, harbor and treat those suffering from small-pox. Even the caring for such patients in isolated pavilions in general hospitals is open to the objection of multiplying the foci of contagion in the city or town. It follows, therefore, that every city and large town should be provided, either temporarily or permanently, with a special institution for the treatment of this disease in the event of its outbreak. The hospital should be located in a healthy locality sufficiently removed from inhabited domiciles to render impossible the transmission of the disease. When possible, the hospital should be a mile distant on all sides from any populated settlement. Experience has proved that within this radius there is considerable danger of aërial transmission of infection. The hospital should be constructed in a modern manner, with a view to making the unfortunate patients as comfortable as possible.

Of course, a special hospital of this character should be managed under strict quarantine regulations. No person, however well protected, should be allowed to visit a patient in the institution except under extreme circumstances, and then only after every possible precaution shall have been taken to prevent his carrying away the infection. The nurses and attendants should not be allowed to leave the hospital nor come in contact with other persons until they have had an antiseptic bath and have changed their infected clothing. In providing nurses and other employees for the hospital it need not be required that they shall have had small-pox, but they should invariably be vaccinated or revaccinated before entering upon duty. When delay is possible, it is wise to await the result of such vaccination before the individual is brought into the infected atmosphere. The hospital should be supplied with closed ambulances for the transportation of patients. Lest infection be spread by the ambulance itself, it should be disinfected and provided with clean bedding, blankets, etc., each time it is used.

If the small-pox patient is to be treated at home, every possible effort should be made to seclude him from all persons, excepting only such as are required to act as nurses, and they should be protected by recent vaccination. In selecting the apartment for the patient, a room most completely separated from all other parts of the house is to be preferred. If this is not practicable—which is usually the case in the ordinary city residence—the uppermost room of the house should be preferred. It should be well ventilated and, if possible, have an open fireplace in which fire should be kept constantly burning. All unnecessary articles of furniture, such as drapery, upholstery, carpets, etc., should be re-

moved. Every precaution in regard to cleanliness and disinfection of bedding, clothing, and everything in use in the room should be exercised, so that the danger of spreading the infection shall be reduced to the minimum. A sheet wrung out of a strong solution of carbolic acid, Labarraque's liquid, or some other disinfectant and suspended across the doorway may aid in preventing the infection from being disseminated to other parts of the house. The spaces around the doors that are not in use, which communicate with parts of the house to be protected, should be sealed by pasting strips of wrapping paper over them.

Surveillance or Quarantine.—When small-pox appears in a house, the question arises, What shall be done with the exposed but well members of the household? If the patient is treated at home, the other inmates as well as the sufferer should be quarantined. For, if removed to another locality, save to a quarantine station or hospital, the disease might subsequently appear there and a new center of infection be thus established. To depend upon people voluntarily to curtail their personal liberty for the public good would be confiding too much, at the present time, in human benevolence and public spirit. Therefore, the best results will be obtained, when the patient is retained at home, by stationing reliable guards about the house to enforce detention of the exposed inmates and also all other necessary precautionary measures.

On the other hand, when the patient is removed to the hospital it is not necessary to enforce the above-mentioned restrictions. Indeed, the object desired is often defeated in large cities by a routine quarantine of the inmates of houses from which small-pox patients have been removed. To make such a quarantine effective the individuals should be detained for a period of eighteen days, the outside limits of the stage of incubation. Segregation of the inmates of the household for so long a period works a great personal hardship and prompts them in many instances to escape before the quarantine is placed upon the house. Persons frequently flee from houses where there exist individuals suspected of having small-pox, but in whom the diagnosis has not been definitely made. The settling of these exposed persons in different parts of the city and in other cities results in the outbreak of the disease in these various localities. Thus, instead of limiting the infection, rigid quarantine laws may favor its dissemination. Furthermore, unpopular restrictive measures tend to provoke evasion of the law and concealment of the existence of the disease.

When the patient is removed to the hospital, immediate vaccination of the exposed individuals should be performed. To avoid, as far as possible, failures through imperfect virus or technic, three or four insertions with different virus had better be made. At the same time there should be thorough disinfection of the infected articles and apartments. After this has been accomplished, the exposed individuals might resume their freedom. They should, however, be kept under medical surveillance and should be daily visited by a physician, who should watch for any symptoms of variola. Such inspection should be continued for sixteen days from the onset of the disease in the original

patient, at the end of which time the suspected individuals, if well, may be exempted from further surveillance. During his visits the physician can determine whether the vaccination is "taking," and, if not, the procedure can be repeated, thus giving the patient a still further chance for protection if vaccinal susceptibility exists.

The above plan is based upon the assumption that small-pox is not contagious during the period of incubation, and this view is in accord with the belief held by practically all authorities on the subject. Until active symptoms manifest themselves the exposed individual is not a menace to the health of the community, and it is unnecessary and injudicious to restrict his liberty during this period. Furthermore, a large experience has demonstrated that under a system such as outlined a *much larger percentage of exposed individuals will submit to vaccination and a correspondingly increased number of patients will consent to be removed to the hospital*, for only those who comply with this advice will be exempt from quarantine.

Apart from these considerations, the system of routine quarantine, during epidemic prevalence of small-pox, will be found to involve the expenditure of large sums of money.

The quarantining of exposed persons may be practicable and wise in dealing with sporadic cases of small-pox or with the first or last cases in a community, for under such circumstances extraordinary precautions are justified in an endeavor to limit the outbreak of the disease to the original patients.

It is a wise plan to placard houses in which small-pox develops in order to warn the public against approaching within infecting distance.

Disinfection.—In the prophylactic treatment of small-pox, disinfection occupies a prominent place. It is desirable, during the progress of the illness of the patient, to take such precautions as will lessen the contamination of the sick apartments and the contained objects to a minimum, and after recovery or death of the patient to completely destroy the infectious principle. All articles employed by the patient and the apartments occupied by him become intensely infected. It is an important matter, therefore, to have the sick room and adjoining apartments as bare of furniture as is compatible with the comfort of the patient and the exigencies of nursing. Sunlight and fresh air are valuable natural purifiers, and an abundance of both should be supplied to the sick apartments.

All discharges from the patient should be received into a vessel containing bichlorid of mercury, carbolic acid, or some equally efficient germicide. Excreta should under no circumstances be permitted to escape into the public sewer without having first been disinfected. The body- and bed-linen of the patient should be immersed in a 5 per cent. solution of carbolic acid or a 5 per cent. solution of formalin for a half-hour before being removed from the sick room; the linen should then be boiled.

Those in attendance upon the patient should not be more numerous than circumstances actually demand. They should be thoroughly

impressed with the importance of confining the infection to the chambers set aside for the care of the patient.

The garments worn by nurses and attendants should be of such material as will stand boiling and laundering. Before leaving an infected apartment and coming in contact with the outer world, the attendant should take a thorough bath, shampoo the hair with an antiseptic soap, and don perfectly clean and uninfected clothes.

Physicians should be careful to exercise all necessary precautions in visiting a patient with small-pox, for the infection can be readily carried in their garments. A linen gown covering the body from the neck to the ankles should be worn, and a linen cap should completely cover the hair. The physician should also wear rubbers in order to avoid carrying away any particles of variolous crusts that might adhere to the shoes. This accoutrement should be kept in an uninfected apartment which is thoroughly well ventilated. The physician should remain no longer in the sick room than is absolutely necessary. On leaving the patient the physician should thoroughly wash the face and hands, preferably with an antiseptic soap.

The patient should be completely isolated until the skin is smooth and entirely freed of crusts. In extremely mild and modified cases this may require but a week or two; in severe confluent cases the period will extend to a month or six weeks. Care should be taken to see that no dried horny pocks remain in the epidermis of the palms and soles. The patient before coming in contact with the world should shampoo the hair with carbolized soap, take an antiseptic bath, for example, in a 1:10,000 solution of bichlorid of mercury, and should garb himself in clean and uninfected garments.

In the event of death, the corpse should be thoroughly wet with a strong solution of corrosive sublimate, carbolic acid, or formalin, and be wrapped in a sheet immersed in one of these disinfectants. When cremation cannot be carried out, the body should be placed in a hermetically sealed metallic coffin. The casket should be buried at least 6 feet beneath the soil. It is obvious that the family should not be permitted to inspect the body nor come in contact with the coffin.

After vacation of the sick room, the apartment must be thoroughly disinfected. Articles of little or no value may be destroyed by burning. All articles capable of being boiled should be immersed in boiling water for at least half an hour. Clothing, carpets, and bedding are best disinfected by exposure to superheated steam in a cylinder. The room should be thoroughly disinfected by formaldehyd vapor supplemented by spraying with formalin. If formalin cannot be procured, sulphur fumigation thoroughly carried out will suffice. The destructive influence of sulphur dioxid on fabrics, etc., should be remembered. After thorough fumigation, the wall paper should be moistened with a carbolic acid solution and scraped off, the paper being subsequently burned. An apartment which has been occupied by a small-pox patient should be aired for several weeks before it is again occupied.

Vaccination is, as is well known, the most important of all the prophylactic measures employed to prevent small-pox. If vaccination were universally practised and repeated at proper intervals, there would be little need for other means of prevention. Whenever small-pox develops in a household, it is the immediate and imperative duty of the physician to vaccinate all persons who have been exposed to the disease. Not only should the unvaccinated be promptly protected, but those previously vaccinated should be revaccinated, regardless of the character of their former vaccinations. Those never successfully vaccinated should be vaccinated at several different sites with lymph preferably from different sources, so as to decrease the possibility of an unsuccessful result and thus protect the individual against the danger of an attack of unmodified small-pox. Under such circumstances the individual is prone to be *vaccinated after infection* and, therefore, during the *stage of incubation* of small-pox. Despite this fact there is no doubt of the utility and protective influence of vaccination if it be not too long delayed. In order that protection shall be complete, the vaccine virus must be introduced almost immediately after the reception of the variolous poison. If the vaccination is performed a few days later, it is still apt to exert a modifying influence upon the developing disease.

No stage of the incubation period should be considered too late to try vaccination, for if, as sometimes happens, the incubation period be unusually prolonged, a late vaccination may still exert a favorable modifying influence.

The vaccine disease exerts its prophylactic power about the time that the areola forms and constitutional symptoms develop, therefore, about the seventh or eighth day. If this stage is reached before the variolous fever manifests itself, small-pox may be entirely prevented. The initial symptoms of small-pox develop usually from the tenth to the twelfth day after infection. It is thus seen that a vaccination performed a day or two after infection has the opportunity of working out its protective influence before active symptoms of variola develop. Practical experience teaches that if vaccination be performed upon the first or second day of the incubation period, there is an excellent opportunity of the small-pox being prevented or suppressed. If vaccination is performed between the second and the fifth day, the protection is apt to be partial; after this date the chances of favorably modifying the oncoming disease grow progressively less.

Persons once vaccinated are much more easily protected than unvaccinated individuals, for the course of a revaccination is more rapid than that of a primary vaccination and the protective stage is earlier reached.

It is evident from what has been stated that great care should be exercised in the selection of good active lymph in vaccinating after exposure to small-pox. Failure due to the employment of an inert lymph might be directly responsible for the death of the patient. As has been previously recommended, multiple insertions should be made with several lymphs from different sources to multiply the chances of

success. It is also important that the virus employed should be active and run its course rapidly. In former days, lymph of long humanization was found to be extremely valuable in these cases. Humanized virus is still extensively employed in Mexico for all vaccinations, and it is preferred by the Mexican physicians to animal lymph. In most countries, however, bovine virus has superseded humanized lymph. Glycerinated lymph, properly prepared, has acted very well in vaccinations performed after exposure to small-pox. The glycerinated lymph is to be preferred to the dry lymph on ivory points, which give a smaller percentage of successes. It must be remembered that the difference between success and failure may mean the difference between life and death.

In support of the statement that the vaccine disease does not begin to exert its protective influence until the seventh or eighth day, the following table published by Welch and Schamberg (Acute Contagious Diseases, 1905, p. 294) is presented:

PATIENTS VACCINATED AFTER EXPOSURE

	Cases.	Deaths.	Percentage.
Vaccinated seven days or less before variolous eruption	106	39	38.79
Vaccinated more than seven days before variolous eruption	264	39	14.77
Total	370	78	21.08

From these figures it is conclusively proved that the earlier the vaccination is performed during the period of incubation the greater is the chance of the disease being favorably modified.

Some of the deaths occurring in patients vaccinated more than seven days before the eruption may be attributed to a too tardy development of the vaccine lesion. Most of the patients were vaccinated with bovine lymph, and it is known that this lymph, particularly when used in the form of dry points, is slower in its effect than humanized virus or glycerinated lymph.

Forty-seven persons vaccinated for the first time after exposure to small-pox were perfectly protected against the disease. As these individuals were all under observation in the hospital, where they came in the closest possible contact with small-pox patients, there can be no question that the contagium was present in sufficient quantity to ensure immediate infection.

TREATMENT OF THE ATTACK

During the *initial stage* of small-pox the treatment is entirely symptomatic, and has for its object the alleviation of the distress of the patient. It is the custom to administer some febrifuge mixture, for it will be remembered that the temperature at this period is high. A combination of sweet spirits of niter with lemon syrup and the solution of acetate of ammonia will be found grateful to the patient. An ice-cap to the head and cool sponging will often give relief when the pyrexial symptoms are distressing. Small doses of phenacetin may be given to alleviate the severe headache. Nervous symptoms, such as insomnia, delirium,

and convulsions, are often prominent symptoms and demand appropriate treatment. The bromid salts or chloral will be found useful in combating these symptoms. For the severe backache, phenacetin may be employed; this failing, resort may be had to morphin. The practice of applying a mustard plaster to the lumbar region should be condemned, for the cutaneous irritation thus produced frequently leads to a confluence of the eruption over this area.

The diet during this period should consist largely of milk and broths. Thirst may be assuaged by the use of pellets of ice, carbonated drinks, iced lemonade, etc.

Treatment during the *eruptive stage* should be directed toward the relief of the distressing subjective symptoms. It will be found of distinct advantage in all severe cases to have the hair of the scalp clipped. This not only facilitates the application of cold to the head, but permits of proper treatment of the variolous lesions which are usually abundant on the scalp.

One of the bitterest complaints of the patient during the early eruptive stage is the soreness in the mouth and throat from the presence of variolous lesions. As the disease progresses the vesicles upon the mucous surfaces are converted into superficial ulcerations. Deglutition gives rise to the most distressing pain, and measures must be directed toward its relief. Sometimes simple mouth-washes containing such ingredients as chlorate of potash, boric acid, glycerole of tannin, tincture of myrrh, etc., will suffice. Demulcent drinks made of flaxseed, gum arabic, etc., are often grateful. Frequently these preparations fail to give relief. Orthoform lozenges, each containing 1 gr., allowed to dissolve in the mouth every few hours, will often lessen the pain. In the severest cases it may be found necessary to resort to the use of a 1 per cent. solution of cocain sprayed into the throat before each feeding. The liability of the production of toxic symptoms is slight, as variolous patients appear to tolerate cocain very well.

Pain in the throat and difficulty in swallowing are sometimes benefitted by the use of pellets of ice allowed to slowly dissolve in the mouth. Ice is also useful in those cases in which there is a tendency to the development of glossitis. When there is much fetor arising from the mouth, chlorin-water or a carbolized mouth-wash will tend to correct it. The ice-bag should be applied to the neck for the relief of glandular swelling. In children, if edema of the glottis develops, as it sometimes does, intubation or tracheotomy must be performed; these patients usually succumb ultimately despite the temporary relief in breathing.

During the late eruptive stage patients frequently suffer from inability to sleep and from delirium. The bromids and chloral may be used to combat these symptoms. The remedy, however, which gives the best results is morphin. This drug must be given in full doses to accomplish the desired effect; it is sometimes necessary to administer $\frac{1}{2}$ to $\frac{3}{4}$ gr. in twenty-four hours. Morphin is usually well borne; the mental and physical excitement is quieted and patients awake from their slumber refreshed. The delirium of small-pox is at times violent

and maniacal. The patients exhibit a wild expression of the countenance and may make homicidal or suicidal attempts. Patients in this condition frequently endeavor to escape from the sick room, preferably through the window. Care must be taken to carefully watch such patients, and, if necessary, physically restrain them with sheets, straps, or similar devices. This violent delirium is apt to occur during the early part of the eruptive period rather than at a later stage.

The diet during the eruptive period of small-pox should be nutritious and easily assimilable, consisting chiefly of milk, broths, farinaceous articles, soft-boiled eggs, and the like.

The therapeutic indications during the *suppurative stage* are to mitigate the fever, to lessen the liability of septic absorption from cutaneous lesions, and to sustain the vital forces of the patient. The greatest danger from septicemia and exhaustion exists during the late suppurative period, between the ninth and eleventh days; if the patient's life can be prolonged beyond the twelfth or fourteenth day, the chances of recovery become distinctly improved.

The fever, which remits usually about the third or fourth day of the eruption in severe cases, rises as the cutaneous lesions fill up with pus. The suppurative fever, beginning usually upon the sixth day of the eruption, often reaches a great height, particularly in confluent cases. The thermometer may register from 103° to 106° F. While external cold is largely to be depended upon to combat the hyperpyrexia, the judicious use of small doses of some coal-tar preparation, such as phenacetin, will subserve a useful purpose. The administration of $2\frac{1}{2}$ to 5 gr. of phenacetin, when the pyrexia is high, will often effect a reduction in temperature of one or two degrees, without the production of any untoward symptoms.

Baths.—Small-pox patients do not bear cold tub-baths nearly as well as certain other fever patients. Other hydrotherapeutic measures, therefore, are to be employed to reduce excessively high temperatures. The cold pack has proved effective and is usually well borne, although in cold weather even this method must at times be replaced by the use of tepid packs, owing to the depression caused.

Continuous warm baths are of great value in the treatment of small-pox. Hebra employed this method many years ago. Continuous immersions for a number of hours or days will effectually reduce the temperature and also exert a favorable influence upon the skin. A bath of 95° F. is capable of reducing a temperature of 104° to 100° F. or thereabouts, and maintaining the temperature at about this level. With this reduction of the temperature there is a decrease in the frequency of the pulse and delirium is usually replaced by sleep.

Apart from the antipyretic effect of the continuous warm bath, it tends to macerate the pustules, hastens the discharge of their contents, and thus lessens the liability to secondary pyogenic infections of the skin. The ordinary ward tub, with an adjustable cradle attachment, is admirably adapted to treatment of this character. When the temperature of the water falls below 92° or 90° F., especially in winter,

the patient will usually complain of chilliness. The continuous warm bath requires the services of a special attendant day and night.

During the suppurative stage of small-pox the vital forces of the patient are subjected to the severest test, as a result of the prostrating effect of septic absorption from the pustules. When such symptoms as pallor, general tremor, delirium, and subsultus tendinum develop, stimulants and concentrated nutriment must be liberally given. It is a wise plan not to wait for the development of such manifestations before administering stimulants, but to anticipate them and strengthen the vital forces by the timely employment of alcohol. It is good practice to commence the administration of whisky when the suppurative period begins. This is best given, when well borne, in the form of milk-punch or egg-nog. An adult suffering from confluent small-pox should take from ½ ounce to 2 ounces of whisky every two or three hours in a tumbler of milk. From 2 to 4 eggs should be taken in the course of twenty-four hours. The nourishment should be continued throughout the night, for during this period the vital forces are often much depressed.

If the patient should vomit and not retain the milk-punches or egg-nogs, they must be immediately discontinued. Sometimes it will be found better to give the whisky separately in water. If milk is not well borne, resort may be had to bouillon with eggs, beef-tea, wine, whey, etc. Champagne or some other good wine may be substituted for whisky or brandy when the stomach is disinclined to retain these. In ordinary cases Curschmann highly recommends the cognac mixture of Stokes. The formula is as follows:

℞ Cognac optimi,
Aquæ destillatæ..... āā f℥xv
Vitelli ovi..... No. 1
Syrupi..... f℥vj.—M.
Sig.—Tablespoonful every two hours.

Quinin in 2-gr. doses every three or four hours is useful during the suppurative stage. When the heart exhibits evidence of weakness, digitalis and carbonate of ammonia may be administered, but these must be immediately discontinued if they are not well borne by the stomach. In this event, digitalin may be given hypodermically.

During the stage of retrogression of the eruption the diet may be gradually made more generous, and such articles as milk-toast, wine jelly, custard, and soft-boiled eggs permitted. Tonics containing iron, quinin, strychnin, etc., may be administered with advantage to improve the appetite and the general vigor of the patient. During the stage of involution of the eruption most patients suffer from boils and subcutaneous abscesses; these give rise to an irregular temperature, which may continue for a considerable period of time. The abscesses should be early evacuated and treated according to modern surgical principles.

Many internal remedies have been highly vaunted in the treatment of small-pox. Among these may be mentioned sulphocarbolate of sodium, hyposulphite of sodium, xylol, bichlorid of mercury, salicylic

acid, etc. All of these have failed to fulfil the claims made for them by their several advocates. It must be admitted that there is as yet no treatment capable of exerting a material influence in either shortening or modifying the course of small-pox. While the course of small-pox cannot be abridged, medicinal treatment directed toward the relief of symptoms and the accompanying complications is of great usefulness and importance. In the management of small-pox greater progress has been made in the direction of prevention than cure. In vaccination we possess an agent capable of completely protecting against this terrible and fatal disease.

Red-light Treatment of Small-pox.—A form of red-light treatment of small-pox, albeit based upon a different principle from that of Finsen, was employed by John, of Gaddesden, in the fourteenth century, and doubtless before him by Arabian physicians; its object was to excite the skin and favor the elimination of the poisons of the blood. John, of Gaddesden, though court physician, is said to have been "a very sad knave." Gregory wrote in 1843: "What think you of a prince of royal blood of England (John, the son of Edward the second) being treated for small-pox by being put into a bed surrounded with red hangings, covered with red blankets and a red counterpane, gargling his throat with mulberry wine, and sucking the red juice of pomegranates? Yet this was the boasted prescription of John, of Gaddesden, who took no small credit to himself for bringing his royal patient safely through the disease." Gregory significantly adds: "Let us then avoid the errors of our ancestors without reproaching them."

Picton, Black, Waters, Barlow, and others have employed various methods of excluding the actinic rays of light in treating small-pox.

Within recent years, Finsen, of Copenhagen, has strongly championed the red-light treatment of small-pox. The treatment is based upon the exclusion from the sick room of the actinic or chemic rays of light, which are said to favor suppuration, by the use of red colored screens of one material or another. Finsen, in the summing up of the cases treated by this method, chiefly by Danish and Norwegian physicians, says that out of a total of 140 to 150 cases of small-pox, in 1 case only was the method inefficacious.

In the winter of 1902 Dr. William M. Welch and the writer treated 2 cases of variola in a red room specially arranged for the purpose, with absolutely negative results in both. One patient died during the suppurative fever and the other was badly scarred.

Ricketts and Byles, of London, treated 13 cases of small-pox in thoroughly equipped red-light rooms with negative results. These observers remark "we cannot agree that the treatment has any of the merits which have been claimed for it."

Brayton, of Indianapolis, and others have similarly had negative results. The assertion that the exclusion of the actinic rays of light will prevent suppuration and scarring in severe small-pox in unvaccinated individuals is, I think, seriously to be questioned.

Local Treatment.—The purpose of local treatment in small-pox

is to mitigate the burning, itching, and pain, correct the offensive odor, lessen the intensity of the septicemia, and prevent scarring.

The great variety of therapeutic methods that have been advocated and lauded from time to time is adequate evidence that no one remedy or method of treatment has had sufficient virtue to command the confidence of physicians generally.

Almost every antiseptic remedy known to medicine has been employed at one time or another with a view to prevent pustulation and thus avoid scarring. It may be set down as established by experience that the application of no medicament to the surface of the skin is capable of preventing the development of the variolous pock. Pustulation is not due to contamination with ordinary pyogenic organisms present upon the surface of the skin, but is the result of the action of the variolous parasite itself. In other words, the pustules of small-pox may be regarded as cutaneous abscesses resulting from nature's effort to throw off the causative micro-organisms. I have seen the skin in the papular stage of small-pox thoroughly washed with soap and water, alcohol, ether, and bichlorid of mercury, and then painted with ichthyol-collodion, the last-named application being used twice a day. This antiseptic treatment did not seem to interfere in any way with the formation of the pustules, for they grew up through the ichthyol varnish.

Antiseptic treatment was employed in small-pox and abandoned many years ago before the principles of bacteriology were understood. In 1843 Gregory wrote: "The latest mode of treating the surface during the maturative stage of small-pox is that of applying mercurial plasters containing calomel or corrosive muriate of mercury, or covering the whole surface with mercurial ointment. In the French hospitals at the present time the latter mode is in fashion. The reports which have reached us of its success, however, are not very flattering. I have seen all three plans tried at the Small-pox Hospital. The ointment and calomel plasters were inefficient. The plaster of corrosive sublimate converted a mass of confluent vesicles into one painful and extensive blister, but I am still to learn what benefit the patient derived from the change."

During the early eruptive period the patients complain of burning and itching, particularly of the face and hands. Bland ointments are of use in alleviating this symptom, such as a 3 per cent. ointment of carbolic acid in vaselin or, if the odor be objectionable, menthol or oil of eucalyptus. Carron oil (linseed oil and lime-water) made fragrant with a little cologne is a grateful application.

When the burning and itching are severe, the greatest relief will be obtained from the use of cold applications. Curschmann says: "In severe cases the application of iced compresses to the face and hands or to any parts where the eruption is abundant will diminish the severe pain, lessen the swelling and redness of the skin, and make the patient more comfortable."

Moore advises the application over the face of a "light mask of lint thoroughly soaked in a mixture of iced water and glycerin (1 tablespoonful of the latter in 1 ounce of water) and covered with oiled silk."

The development of the eruption in the thick skin of the palms of the hands and the soles of the feet often gives rise to great pain. Ice-water compresses often give relief, but in the severest cases more benefit appears to be obtained from hot fomentations.

A great variety of methods of treatment have been advised with the view of *preventing pitting in small-pox*. Reference will be made only to those which have been recommended by physicians of large experience. Rayer and others, many years ago, advised opening the vesicles and evacuating the contents. French physicians of a later period counselled evacuation followed by cauterization with a fine-pointed stick of nitrate of silver. The Egyptians and Arabs excluded light and air by covering the face with gold leaf; others, acting on a similar principle, have employed dark-covered plasters and red-light wards. Carbolic acid (pure and diluted) has been applied to the vesicles with alleged good results. Sulphur ointment, 1 to 2 drams to 1 ounce, mercury in plaster and in ointment form, salicylic acid, bismuth, and a host of other preparations have been advocated as possessing ectrotic properties.

The preparation which has given the best results in the Municipal Hospital of Philadelphia is the *tincture of iodin*. Iodin is an old and highly recommended application. It is said that Sargent applied iodin to one-half of the face in 30 cases of small-pox; on the side of the face thus treated it is alleged there was less swelling, the vesicles were flattened, and the pitting was perceptibly diminished, although it was not prevented.

Dr. William M. Welch and the writer employed tincture of iodin in a large number of cases in the Philadelphia Municipal Hospital. The face was painted as early as possible with the undiluted tincture of iodin, the application being made once or twice a day, according to the sensitiveness of the skin. Most patients bear the painting very well, although many complain of smarting for a time after the treatment. In some patients the skin is so sensitive that this mode of treatment has to be abandoned, although a diluted tincture of one-half the usual strength might be applied in such cases. About the eighth to the tenth day of the eruption, in unmodified cases, a thin, dry, parchmenty mask forms, which begins to crack and peel off. At this time it will be found advisable to substitute a mild unguentous application, such as a weak carbolized vaselin or plain vaselin or cold cream ointment. Some writers have made too extravagant claims for iodin applications. The iodin appears to shrink the pustules, to hasten decrustation, and, to some extent, to lessen the pitting, although in severe cases it will not prevent it. The liability to variolous impetigo and to subsequent pyogenic complications is distinctly diminished (Fig. 102). A notable feature of this treatment is that it completely destroys the offensive odor upon the areas of skin to which the iodin is applied.

It may be stated as conclusively proved that none of the highly vaunted remedies for the prevention of pitting are capable of fulfilling this object in severe cases. It must be remembered that many patients,

particularly adults, once vaccinated, are apt to recover from small-pox with little or no pitting. In children, too, recovery often takes place with no indelible scarring. In order to prove the value of an ectrotic remedy it should be employed in severe cases in unvaccinated subjects. In such cases we find that all remedies fail to prevent scarring.

Mild emollient ointments containing small quantities of carbolic acid, aristol, or biniodid of mercury may be employed with advantage. In the early stages of the disease these applications are grateful to the skin, and later on they serve to soften the purulent débris, which can thus be more easily removed from the face. I am not, however, convinced that these preparations are essentially more valuable than plain vaselin or cold cream. In severe cases, where the treatment of the face is neglected, the crusts become blackish (Fig. 103), the odor is more offensive, and the ulcerations appear to be deeper and followed by more disfiguring pitting. Gregory, after a long and rich experience in small-pox, remarks: "There is no peculiar method which can be devised for the prevention of pits and scars. . . . The application of a little cold cream to the hardened scabs is all that is recommended."

To *modify the offensive odor* that emanates from the pustules in severe cases, a dusting-powder may be used containing iodoform 2 parts, boric acid 10 parts, and talcum 28 parts. This can be freely dusted over the body after a bath. If desired, a larger percentage of aristol may be substituted for the iodoform.

Baths are of value in lessening the liability to septicemia. The patient may be given prolonged warm baths and the pustules rubbed open and evacuated. The baths may be rendered alkaline by the addition of carbonate or bicarbonate of soda, or antiseptic by the addition of creolin (1:500) or bichlorid of mercury (1:10,000). Potassium permanganate baths, which have been highly recommended by some writers, were employed at the Municipal Hospital, with anything but favorable results. Where baths cannot be employed, it is a good plan to open the pustules at the height of the pustular stage, evacuate the contents, and sponge the lesions with a 1:1000 solution of bichlorid of mercury.

When extensive impetigo exists, one of the antiseptic dusting-powders above referred to may be employed, or the following ointment may be used:

℞. Hydrargyri ammoniati ..... gr. x
Pulveris amyli,
Pulveris zinci oxidi ..... āā ʒij
Petrolati ..... ʒiv.—M.

In the treatment of small-pox, care of the eyes is a matter of the greatest importance. This subject will, however, be discussed in another chapter.

Fig. 102.—Small-pox, showing effect of iodin treatment; right arm painted with *iodin* from wrist to elbow each day. Photographed on tenth day. Secondary pyogenic lesions entirely restrained (Welch and Schamberg).

Fig. 103.—Small-pox. Case of semi-confluent small-pox on face in a patient entering the hospital on the tenth day. No applications had been used on the face and extensive blackish crusting is present from the drying of the exudation and dirt and dust from the air.

CHICKEN-POX

By Jay F. Schamberg, M. D.

Chicken-pox is an acute, highly communicable disease which occurs chiefly, although by no means exclusively, among children. The incubation period is ordinarily from thirteen to sixteen days. The onset of the disease is usually characterized by fever, variable in intensity. In some cases the pyrexia may be extremely slight, while in other cases the temperature may register 104° to 105° F. The temperature falls rapidly, however, and becomes moderate or reaches the normal. The eruption appears almost synchronously with the development of the fever. Vesicles are present usually when the patient is first seen, although some of the transitional lesions may be observed in the macular or papular stage. The vesicles are thin roofed, superficial, and readily ruptured by pressure. The eruption prefers the covered surfaces of the body, particularly the back, although lesions are usually found upon the face, and also the hands and feet. The mucous membrane of the mouth frequently shows the presence of scant lesions. The eruption comes out in crops and the lesions are, therefore, observed in various stages of development. The course of the eruption of varicella is very short as compared with that of small-pox. The vesicles form crusts in a few days, and these are cast off, leaving reddish stains and occasionally pits from destruction of the true skin.

The disease is transmissible until the skin is freed of all of the crusts. Secondary pyogenic infection commonly occurs about the lesions, but the crusts formed as a result thereof do not appear to contain the infection of the disease. It has not been positively determined whether varicella can be inoculated with fluid from the vesicles.

Treatment of Chicken-pox.—When chicken-pox appears in a household, it is scarcely necessary to isolate the patient. Varicella is such a mild disease that it is just a question whether children in good health should not be allowed to take it. Those who reach adult life without passing through the disease are apt to contract it at times under awkward and embarrassing circumstances. When children are weakly or suffering from some other disease, they should, if possible, be protected against chicken-pox. When isolation is carried out it should be continued until detachment of all the primary crusts.

The constitutional symptoms of varicella are ordinarily so mild as to require no internal treatment. Where there is a febrile disturbance, children should be kept in bed and upon a bland diet.

The local treatment is of considerable importance. When the vesicles become distended with pus, particularly those on the face, they should be evacuated and cleansed with a weak antiseptic solution. An excellent plan is to daily paint the facial lesions from their inception with tincture of iodin, diluted one-half with alcohol. The painting has a shrinking effect upon the lesions. The following ointment will be found useful in preventing secondary infection of the lesions:

℞. Acidi carbolici ..... gr. x
Hydrargyri chloridi mitis ..... gr. xv
Pulveris amyli,
Pulveris zinci oxidi ..... āā ℥ij
Petrolati ..... ℥iv.—M.

As has already been stated, some chicken-pox lesions are followed by indelible scars; these may be due to an early necrosis involving the papillary layer of the skin, in which event they cannot be prevented. In other cases the scars are due to a slow ulceration, the result of pyogenic infection of the lesions. Scratching is liable to produce scars by infecting the skin. In young children the finger-nails should be closely trimmed to prevent traumatism from scratching; when scratching cannot be otherwise controlled, the hands should be enclosed in muslin bags attached firmly to the wrists. Doubtless the rare cases of varicella gangrænosa are due to infection of the skin. It is important to keep the hands and the entire body scrupulously clean.

To relieve the itching which is not infrequently present the following lotion will be found efficacious:

℞. Acidi carbolici ..... ♏xl to ℥j
Glycerini ..... ℥j
Spiritus vini rectificati ..... f℥j
Aquæ ..... q. s. ad. f℥vj.—M.
Sig.—Use locally.

In severe cases it is important to examine the urine to be sure that a nephritis be not present. If the latter complication arises, it should be treated upon the usual principles governing the care of this condition.

CEREBROSPINAL FEVER

By Lewellys F. Barker, M. D.

By cerebrospinal fever we understand an infectious disease due to the arrival of bacteria in the leptomeninges (pia mater and arachnoidea) of the brain and spinal cord, their multiplication there, and the reaction of the body to them and their products. The term cerebrospinal fever is practically synonymous with cerebrospinal meningitis. It does not include, however, cases of chronic meningitis which have had no acute stage, nor is it customary to include under this heading the tuberculous and syphilitic meningitides.

We call cerebrospinal fever an *infection of the meninges*, for, though a similar process may be set up artificially by injection of chemic irritants (iodin, turpentine, dead bacteria) into the meninges, the only cerebrospinal fever thus far met with in nature has been due to bacterial infection of the meninges. In the last analysis, of course, every meningitis is due to meningeal intoxication, but the cases of spontaneous meningitis thus far studied have all been instances of intoxication originating as a result of the entrance of bacteria into the meninges and their growth, multiplication, and death there. Indeed, it appears to be highly probable that it is the *bacteria which die in the meninges*, and dissolve up after their death, that must be held responsible for the principal intoxication. The toxins produced as a result of the metabolic processes of the living bacteria doubtless also do some local and general injury, but the chief excitant of the symptoms and of the pathologic changes in the disease is, it is believed, the "endotoxins," components of the bodies of the bacteria themselves, set free when the bacteria die and undergo so-called bacteriolysis.

No rigid *classification* of the various forms of cerebrospinal fever which occur is satisfactory.

According to mode of occurrence, we speak of *epidemic* and *sporadic* cerebrospinal fever. But the epidemic form does not appear to be associated always with the presence of a single bacterial species, though thus far only two varieties of bacteria have been isolated in the various epidemics studied. On the other hand, the sporadic cases may be due to any one of several varieties of bacteria, and certainly may be due to either of the two bacterial forms which are held responsible for epidemic meningitis. A sporadic case may differ in nowise from one individual case in an epidemic, except in its isolated occurrence.

The grouping of cases under the headings of *primary* meningitis and *secondary* meningitis is no more satisfactory, for, while the obviously secondary cases complicate a pneumonia, a pyemia, an otitis media, a fracture of the skull, or the like, the so-called primary cases are now found to be frequently, if not always, preceded by an infection (with greater or less degree of inflammation) of the nasal cavities, of their accessory sinuses, or of the middle ear. Indeed, it is hard to conceive of a sufficient number of bacteria to cause the disease gaining entrance to the meninges, unless the infectious agent has had the opportunity of multiplying first to a considerable extent somewhere in the body.

An attempt has also been made to classify cerebrospinal fever according to the *portal of entry* of the infecting microörganism. Thus when the bacteria are introduced by a direct injury from without, *traumatic* cerebrospinal fever is spoken of; or the germ may grow through adjacent tissues to reach the meninges, either directly (*meningitis by extension*) or through the lymphatics, for example, along the olfactory nerves from the nose (*lymphogenous meningitis*), or it may be brought by the blood to the meninges (*hematogenous meningitis*), either in cases of general infection of the body or in instances where a primary local infection gives rise to metastases in distant parts through infective emboli.

The use of the *nature of the meningeal exudate or its distribution* as a basis for classification can lead to no sharp definitions or distinctions. For convenience of description, we speak of the *diffuse* and the *circumscribed* meningitides, and of *serous*, *serofibrinous*, *fibrinopurulent*, and *purulent* cases, but the artificial character of such an arrangement is palpable.

Bacteria were early observed in meningitis, but it was not until 1886 that a definite bacterial species was isolated from the exudate. In that year A. Fränkel proved the etiologic relation of the *diplococcus pneumoniæ* to 2 cases of cerebrospinal fever complicating pneumonia, and in the same year Weichselbaum confirmed the finding in 2 similar cases, and asserted that the meningeal infection occurred secondarily to inflammation of the nasal sinuses, especially of the ethmoidal cells, the bacteria passing thence by the lymph-channels to the leptomeninges. In 1887 Weichselbaum discovered the *micrococcus meningitidis* (which he then called the diplococcus intracellularis meningitidis) in 6 cases of "primary meningitis." This micrococcus resembles the gonococcus morphologically; it is easily distinguishable from the diplococcus pneumoniæ, for it is not lanceolate, but has a biscuit-shaped form, is not encapsulated, does not stain by Gram's method, is met with chiefly inside the protoplasm of the leukocytes in the exudate, grows characteristically on culture media, and differs strikingly from the diplococcus pneumoniæ in that it is less pathogenic for animals (mice, rabbits). The micrococcus meningitidis closely resembles Pfeiffer's micrococcus catarrhalis, indeed, is morphologically indistinguishable from it, but cultural methods are sufficiently differentiative.

In addition to the micrococcus meningitidis and the diplococcus pneumoniæ as exciters of cerebrospinal fever, it has been proved that a whole series of other bacteria may be the cause of meningitis. Thus, the following bacteria have, in addition to the two just mentioned, been proved to act causatively: the *Streptococcus pyogenes*, *Staphylococcus pyogenes*, *Bacillus influenzæ*, *B. pneumoniæ* (*Friedlænderi*), *B. typhi abdominalis*, *B. coli communis*, *B. mallei*, and the *B. pestis*. But meningitides due to these microörganisms are relatively rare; the cases in which they occur are all sporadic and secondary. The epidemic and primary meningitides are due, as far as is known at present, either to the micrococcus meningitidis or the diplococcus pneumoniæ. Some believe that epidemic cerebrospinal fever is always due to the micrococcus meningitidis and never to the diplococcus pneumoniæ. Certainly the micrococcus meningitidis is very commonly the cause. According to Councilman, Mallory, and Wright, it was the exclusive bacterial cause in the Boston epidemic; Faber found it in the Copenhagen epidemic, and recently it has been isolated repeatedly in the epidemic prevailing in New York. Jager believed that it was the exclusive cause in the epidemic he studied, but his descriptions of his cultures are not wholly in accord with the known cultural characteristics of the micrococcus meningitidis.

There is much evidence, however, that the diplococcus pneumoniæ may be the cause of actual epidemics of cerebrospinal fever as well as of sporadic cases. Thus Foa and Bordoni-Uffreduzzi, Weichselbaum, Quadu, and others assert positively that they have isolated it and identified it in true epidemic meningitis. In the large epidemic at Lonaconing in the Cumberland mountains of Maryland, Flexner and Barker, in coverslips of the exudate from 2 cases, saw cocci which they took to be the diplococcus pneumoniæ; the conditions of the investigation interfered, however, with their cultural experiments. Now that the morphologic and cultural characteristics of the micrococcus meningitidis and the diplococcus pneumoniæ are more thoroughly and generally understood, there will be no trouble in deciding the matter definitely. We know positively that the micrococcus meningitidis has been the bacterium exclusively present in epidemics recently studied. If epidemics due to the diplococcus pneumoniæ have occurred, they will doubtless occur again. For the present the possibility that each of two organisms, the micrococcus meningitidis and the diplococcus pneumoniæ, may be the cause of epidemic cerebrospinal fever should be borne in mind.

The commonest bacterial excitants of cerebrospinal fever, the diplococcus pneumoniæ, the micrococcus meningitidis, the streptococci, and the staphylococci are ubiquitous. Indeed, many of us carry one or more of them about with us in the mucous membrane of the nose or throat all the time. The *epidemiology* of cerebrospinal fever is peculiar in many ways. Epidemics of cerebrospinal meningitis are totally unlike epidemics of cholera, of plague, or of typhoid fever. The epidemics do not spread out from a center, as do the "contact" or

chain-like epidemics, nor are they "explosive," like water epidemics. In Lonaconing, for instance, cases appeared in widely separated parts of the town simultaneously in the absence of any communication among the people attacked, and similar observations have been made in many other epidemics. But while it may appear in this way synchronously at many points, it may also apparently at times be limited to definite localities—to schools, jails, orphan asylums, or barracks. Another peculiar feature of epidemic cerebrospinal fever is this—the number of cases in a given epidemic does not gradually increase until a maximum is reached, and then decline; there is no curve corresponding to that of epidemics of many other infectious diseases; on the contrary, marked intermissions occur in the general course of the epidemic, and this is at present inexplicable. Nor can any satisfactory rule be laid down regarding the length of time a single epidemic may last. Some epidemics die out in a few weeks, others last as long as a year.

Course and Tendencies of the Disease.—The onset is usually sudden, though in some cases the symptoms appear more slowly. In the *foudroyant* cases, death may occur in from six to eight hours after the first symptom. There are all gradations between such frightfully acute cases and chronic cases, extending over several weeks or even months. In the subacute and chronic cases intermissions and exacerbations are common.

After the microörganisms gain entrance to the meninges their metabolic poisons, or the endotoxins derived from bacteriolysis, cause a local injury with resulting acute inflammation. If poisoning is extreme, death may occur with very few local changes in the meninges, aside from acute hyperemia and serous or serofibrinous exudate. If the poisons be set free more gradually or the organism be less virulent, the meningeal exudate becomes more purulent, polymorphonuclear leukocytes being abundant in it. Among the leukocytes are to be seen large phagocytic cells, in all probability derived from the proliferating endothelium of the pia. In the sporadic cases the exudate may be limited largely to the cerebral meninges, but in all epidemic cases and in most sporadic cases both the spinal and cerebral meninges are involved. The violent headache, the vomiting, the sensitiveness to noise and light, the frequent occurrence of chill, and of herpes on the lips make the diagnosis probable. As soon as the rigidity of the neck appears, or Kernig's sign[1] develops, the existence of the disease is probable. Study of the fluid obtained by lumbar puncture will usually permit of a positive diagnosis even earlier, and of a diagnosis not only of meningitis, but also of the particular microörganism which is acting as the exciting agent. This etiologic diagnosis has become even more important since specific therapy has advanced. In the severe cases convulsions often occur, and after a few days or a week the patient may become comatose. Paralysis of individual cerebral nerves becomes evident; complicating inflammations of the eye or the ear develop. If

[1] [This sign is not pathognomonic. It may be absent in meningitis, or it may occur in typhoid fever or uremia in the absence of meningitis (Clark, Oppenheim, *et al.*).—Ed.]

the case is to terminate fatally, the coma persists, the patient loses weight rapidly, there are involuntary movements of the bowels and incontinence of feces, the heart gradually weakens, and the patient dies often at the end of the second week of the attack.

Cases that run a favorable course are usually rather mild from the beginning. There may be no coma whatever, and the temperature does not continue high, being often remittent. In the course of a week or ten days the symptoms ameliorate, the patient becomes less sensitive, his appetite returns, and convalescence begins.

In every large epidemic numerous abortive cases are seen, and there are also always a certain number of cases which run a prolonged and intermittent course. Indeed, a case which has been mild and has promised to terminate speedily in convalescence may show recurrence.

In the cases which ultimately get well, some symptoms may remain for a long time; thus, headache, ringing in the ears, disturbance of the balance of the eye-muscles, impairment of vision and of hearing may persist for a long time in convalescence.

Of the complications of cerebrospinal fever the most frequent and important are otitis, iridochoroiditis, panophthalmitis, bronchopneumonia, pleuritis, arthritis, endocarditis, and pericarditis. The sequelæ in cases which recover spontaneously are important and often grave. Young children are very apt to be left deaf and dumb or idiotic, and either children or adults may be rendered permanently deaf or blind. Chronic hydrocephalus is not an uncommon sequel. Paralysis of any one or of several of the cranial nerves may persist and be permanent.

Mortality and Cause of Death.—The rate of mortality in meningitis is very high. In the epidemic form the mortality varied from 25 to 75 per cent., and, as a rule, fully one-half of the cases died. Death may be due either directly to the intoxication itself or to the mechanical effects of the exudate. The prognosis is distinctly bad in cases of violent onset with high fever and early coma. The milder cases in which no coma develops are the most favorable. If the patient is to get well, he usually begins to improve during the second week, and if there is no improvement by the third week, the prognosis is grave. Often, when the meningeal process itself is insufficient to lead to a fatal issue, some one of the serious complications may cut short the life. With the use of Flexner's serum the mortality in the epidemic form does not exceed 25 per cent.

Main Objects of Treatment.—Aside from prophylaxis, the main objects of treatment are to increase the resistance of the body and to favor the natural mechanisms of defense; to lessen the local effects as far as possible by controlling the inflammation; to relieve the symptoms; and to avoid complications.

Now that we know that cerebrospinal meningitis may be due to any one of quite a large series of microörganisms, but most often to the micrococcus meningitidis or the diplococcus pneumoniæ, and that it is most likely to occur toward spring among people who are closely crowded together and living otherwise in unhygienic circumstances, we

have some clues to a rational prophylaxis. Just how much can be done to prevent the entrance of the bacteria concerned from without into the body is uncertain. There is some evidence that the virulent diplococcus pneumoniæ and micrococcus meningitidis may be transferred from one person to another by handkerchiefs or by the spray of coughing and the like. It is not impossible, however, that in times of epidemics, and even in intervals between epidemics, a large proportion of individuals carry about in their nasal or bronchial mucous membranes the microörganisms concerned, and that it is only when the virulence of the microörganism is, in some way now not understood by us, increased, or when the resistance of the individual is lowered by trauma, exposure to cold, fatigue or excess of some sort, that a local infective process is set up—in other words, the infection may, in a sense, be autogenic.

The most rational prophylaxis, then, in times when cerebrospinal fever prevails will consist: (1) in avoiding any possibility of contact infection; (2) in avoiding all predisposing causes to infection, and especially all influences such as are known to depress the general health or to predispose to a common cold. It is not necessary to go into these influences in detail, as they are known to all, but evidence is increasing that if rhinitis, pharyngitis, bronchitis, otitis, tonsillitis, and inflammation of the accessory sinuses of the nose be prevented, cerebrospinal meningitis is not likely to develop; at any rate, in most of the cases of cerebrospinal meningitis examined, evidence of a preëxisting infection of some one of the mucous membranes mentioned is nearly always found. Ignorance as to the exact conditions underlying infection in cerebrospinal fever often leads to fear among the people in which an epidemic is prevailing, and physicians and the press should use their influence to prevent a panic. In spite of the apparent ubiquity of the causative microörganisms, and of the peculiar character of the mode of spread, epidemiologists are becoming more and more convinced of the importance in cerebrospinal meningitis of the diseased human being as a source of infection for others. Only recently isolation was regarded as unnecessary; now it is urged, as is immediate bacteriologic recognition and obligatory notification of the health authorities. In every suspicious case a lumbar puncture should be made at once, and the fluid examined for pus cells and for bacteria. Should they be present, and especially if the microörganism be the micrococcus meningitidis, the patient should be immediately isolated in a well-aired room and put in charge of a trained nurse, who is given especial instructions regarding the precautions to be taken. The nasal and buccal secretions must be carefully guarded against; care should be taken to make sure that they do not contaminate the pillow or bed-linen, and especially that they never reach the floor; soiled handkerchiefs should be carefully collected and sterilized before they leave the room by soaking in 1 : 500 sublimate or in lysol solution; bed-linen when changed should be similarly sterilized. The floor of the room should be washed thoroughly with strong sublimate solution once daily. Physicians, nurses, or relatives who have

been or continue to be near the patient should use antiseptic nasal sprays and mouth-washes daily. Should any of them develop a "cold" or any other suspicious symptoms, he or she should be isolated until a bacteriologic examination of the secretions has been made.

If the patient dies, or after he recovers, the room and house should be thoroughly disinfected, the floors with strong solution of sublimate, the rooms and house with formalin vapors. Bedding and mattresses should be sterilized by steam.

There is some evidence that dust from dried nasal secretion, carried through the air, may transport the disease. At any rate, until knowledge is more definite on this point, care should be exercised to prevent the drying of secretions and dust contamination.

Where the disease is epidemic in a small town, as it was in Lonaconing, a system of generalized disinfection should be undertaken; the whole place should be thoroughly "cleaned up"; sewage should be properly disposed of; the floors of houses in which cases have occurred should be flooded with sublimate solution, and the houses subjected to formalin disinfection. Immediate measures toward the provision of liberal air space for each inhabitant, especially in the sleeping rooms, should be undertaken. The people should be advised to spend at least two hours in out-of-door exercise each day; in the panicky conditions which prevail some are afraid to go out of doors at all.

An individual "catching cold," or showing any other suspicious symptoms in times of epidemic, should stay in bed for twenty-four or forty-eight hours, take hot drinks, and a light diet. Unfortunately, most of the cases of meningitis, however, appear out of a clear sky. The only prodromata are slight chilly sensations, mild headache, or pain in the back. The patient thinks nothing of these symptoms until, after twenty-four or forty-eight hours, the more violent symptoms appear, often almost explosively.

Once the disease had set in, that is to say, once the bacteria had gained an entrance into the meninges and begun to multiply there, and through metabolic activity and bacteriolysis had begun to set free the poisons which call forth the symptoms, the treatment which could be undertaken up to the time of Flexner's studies had to be largely palliative. We had no satisfactory specific remedies for the disease. *None of the sera prepared to counteract the poisons produced by the various bacterial excitants had been shown to have any therapeutic value.* Nor were we able up to then to plan a very rational mode of combat. If we had known some way of inhibiting the growth of the organism within the meninges, or of restraining the bacteriolysis which sets free the endotoxins of the organisms, or of neutralizing the endotoxins before they produce their effects upon the vessels and tissues of the neighborhood, or of inhibiting the very violent reaction to the injury, we could have dealt with the disease more rationally. But knowledge of all these points was almost wholly wanting. We knew almost nothing about natural immunity against the micrococcus meningitidis, and the same was true regarding acquired immunity. It had been shown, how-

ever, that the serum of convalescent cases of epidemic meningitis has high agglutinating power and increased bacteriolytic effect upon the micrococcus meningitidis. Concerning artificial immunity, there were but few results to be reported. The studies of Jaeger, on the one hand, and of Lepierre, on the other, indicated that an agglutinating anti-infectious and slightly antitoxic serum can be artificially produced, but these studies were only a beginning.

Since Simon Flexner began his studies of experimental infection in monkeys and guinea-pigs with the Diplococcus intracellularis, and his work upon an antimeningitis serum, our ideas regarding the power of physicians to influence the course of a meningitis have been wholly changed. Flexner's experiments began in 1905 and were continued steadily during the next five years. After having familiarized himself with experimental meningitis in monkeys, Flexner began the testing of antisera by means of injection into the infected and inflamed subarachnoid cavity. Some work had been done in Germany by Kolle and Wassermann with an antiserum, but injections of it into the blood or subcutaneous tissue had no especial beneficial effect. Jochmann had injected an antiserum prepared in the horse into the subarachnoid cavity of several human subjects of epidemic meningitis, but his cases were too few to permit of any conclusion as to the value of the injections, though they did demonstrate that the injection of horse's serum into the inflamed subarachnoid cavity of human beings is not attended with special danger. Flexner (1907), by employing a homologous antidiplococcus serum, proved in several monkeys that they could be saved from death due to experimental infection with the Diplococcus intracellularis.

In 1908 Flexner and Jobling made a report upon the serum treatment of epidemic cerebrospinal meningitis in which they described the effects of a diplococcus antiserum prepared by them in the horse and tested upon several series of cases of epidemic meningitis occurring in human beings in New York, Philadelphia, Ohio, Scotland, and Ireland. In this first report the series of cases treated with the serum by Dr. Ladd, in Ohio, yielded statistics which were very encouraging. Flexner's success was largely the result of his happy insistence upon the subarachnoid use of the curative serum.

The antiserum was introduced directly into the subarachnoid cavity after the withdrawal of cerebrospinal fluid by means of lumbar puncture. The quantity of antiserum injected at a single dose amounted to 15 or 30 cc. The injection is made slowly and carefully, so as to avoid the production of symptoms due to increased pressure.

The serum is injected every twenty-four hours for three or four days or longer. The earlier the injections are made, after the diagnosis has been arrived at, the better the results. Bacteriologic examinations of the fluid by cover-slip and culture will determine whether or not the infection is due to the Diplococcus intracellularis, but if the character of the fluid or the cover-slip preparations alone make it seem probable that epidemic cerebrospinal meningitis exists, the serum should be injected at once without awaiting the full bacteriologic report. An injection in

cases of pneumococcus infection or tuberculous meningitis will do no harm, while if the case be one of epidemic meningitis the early treatment is most important.

The direct effect of Flexner's serum appears to be the production of rapid degeneration of the diplococci present in the exudate, and an arrest of their free multiplication. The serum may possess certain direct antitoxic properties also which tend to diminish the dangers of endotoxin intoxication, though further studies in this direction are needed.

In September, 1908, Flexner and Jobling published an analysis of 400 cases of epidemic meningitis treated with the antimeningitis serum, and at the Association of American Physicians, in 1909, Flexner read a paper on "The Present Status of the Serum Therapy of Cerebrospinal Meningitis," in which he gave the results following upon the use of the serum in 712 cases in which the bacteriologic diagnosis had been made. These results are shown well in two tables.

TABLE I.—*Cases of Epidemic Cerebrospinal Meningitis Treated With the Antimeningitis Serum.* (Cases Analyzed According to Age Groups.)

Age.	Total number of cases.	Recovered.	Died.	Per cent. mortality.
One to two years	104	60	44	42.3
Two to five years	112	82	30	26.7
Five to ten years	113	95	18	15.9
Ten to fifteen years	101	73	28	27.7
Fifteen to twenty years	107	72	35	32.7
Twenty years and over	175	106	69	39.4
Total	712	488	224	31.4

Table I brings out several points of interest. The highest mortality is shown to have occurred in the first two years of life. But, contrary to the rule under the older forms of treatment, in which the mortality was 90 per cent. or over, in this series it was 42.3 per cent. The second age period is from two to five years, in which the mortality was 26.7 per cent. The third age period embraces children from five to ten years of age, and gave the lowest mortality of all, namely, 15.9 per cent. The next period extends from ten to fifteen years, and gave a mortality of 27.7 per cent. The next period, of from fifteen to twenty years, showed a considerable rise in mortality, equaling 32.7 per cent., and the last period, embracing the cases of twenty years and over, gave the highest mortality of all, namely, 39.4 per cent. The average mortality in all the age periods was 31.4 per cent.

Table II is instructive in bringing out the importance of early injections of the serum. The results in the first two years of life are especially noteworthy. The extraordinary figures given under the first period of injection, namely, in the first three days of the disease, can hardly be maintained. But the influence of the period of injection is shown by the rapid rise in mortality in the subsequent two periods. The rule of the effects of early injection is preserved in the age periods up to the period of from fifteen to twenty years, when it disappears. The

discrepancy occurring in the two highest age periods cannot be wholly accounted for at present. The explanations which suggest themselves are that among older individuals there tend to be a large number of very severe, rapidly fatal, or fulminating cases of the disease, or that older persons are less subject to the beneficial action of the serum. As regards the second proposition, it may be stated that adults not infrequently respond promptly to the serum injections by abrupt termination of the disease or ameliorated symptoms and pathologic conditions.

TABLE II.—*Cases of Epidemic Cerebrospinal Meningitis Treated With the Antimeningitis Serum.* (Cases Analyzed According to Day of Injection.)

Period of injection.	First to third day.			Fourth to seventh day.			Later than seventh day.		
Ages.	Recovered.	Died.	Mortality. Per cent.	Recovered.	Died.	Mortality. Per cent.	Recovered.	Died.	Mortality. Per cent.
One to two years...	16	1	55.8	20	10	31.2	22	33	60.0
Two to five years..	24	6	20.0	42	12	23.0	18	12	40.0
Five to ten years...	43	8	15.6	3	6	14.6	17	4	19.0
Ten to fifteen years.	36	8	19.0	23	9	28.1	14	11	40.0
Fifteen to twenty years.....	25	17	40.4	25	8	24.2	22	10	31.2
Twenty years and over.....	36	21	36.8	34	24	41.3	36	24	40.0
Total.....	180	61	25.3	179	69	27.8	129	94	42.1

The total figures do not, however, fail to indicate that the early injections are more effective than the later ones, as is shown by the percentage mortality in the first to third day period of 25.3 per cent., in the fourth to seventh day period of 27.8 per cent., and the period later than the seventh day of 42.1 per cent.

It may be interesting to compare the results of treatment of epidemic meningitis in the Johns Hopkins Hospital since Dr. Flexner's serum has been available with the results in cases treated earlier in the history of the hospital. About the same number of cases were treated during one year with serum as were treated during the previous eighteen or nineteen years of the hospital's experience without serum. Dr. Sladen, who at my request made the bacteriologic examinations and lumbar punctures, and injected the serum, has analyzed the statistics; during the first eighteen or nineteen years of the hospital's experience there were between 70 and 80 per cent. of deaths and between 30 and 20 per cent. of recoveries. During the one year of treatment with serum there were about the same number of cases, and there were about 80 per cent. of recoveries and about 20 per cent. of deaths. The figures are just turned around. The effects of the serum seem very striking to us, and we feel most encouraged.

The chronic cases, as well as the acute, may be benefited by the treatment. We had one boy who came up from Georgia, who had been sick several weeks, and was not improving at all. Lumbar puncture was made. The meningococcus was present. The serum was used, and the boy went on quickly to recovery. Possibly we may come to use intraventricular treatment in chronic cases and in the cases of hydro-

cephalus. Dr. Sladen and Dr. Cushing treated one case that way, and the method is certainly worthy of trial.

It seems probable that up to date about 1000 cases have been treated with the serum, and the results thus far are very promising, though, as Flexner himself emphasizes, we must await a still larger number of cases in a whole series of epidemics before we can be fully acquainted with the degree of efficacy of this serum. For the full details of the management of individual cases the article by Sladen in the Johns Hopkins Hospital reports should be consulted.

Certain measures have been resorted to empirically. Complete rest is regarded by all as essential. The head of the bed should be raised. The patient should lie upon a comfortable pillow and the garments about the neck should be loose. The room should be darkened and all unnecessary noise prevented. In towns, tan-bark or saw-dust may be spread upon the streets near the house to prevent the noise of passing vehicles. The patient should, if possible, have a room in a quiet district, away from railroad trains and street-car lines. No violent sensory impression should reach the patient's cerebrum. A water-bed or air-mattress is desirable.

Counterirritation is frequently resorted to, such as blisters to the head or the application of tartar emetic ointment to shaved regions over the parietal bones. I am very doubtful whether it ever does any good, and it certainly makes the patient uncomfortable. It is better to apply ice-bags to the closely cropped head, and if the pain is very severe give morphin; moderate leeching over the mastoid process may be advisable. Inunctions of unguentum cinereum or unguentum argent (Credé) have been recommended as "anti-infectious" measures. It is customary to begin the treatment with a mild calomel purge, in order to make sure that the intestine is empty and that no absorption therefrom can aggravate the symptoms.

In case of secondary meningitis, the primary cause must, of course, always be sought, and if pus has collected anywhere it must be located and evacuated. Often the trephining of the mastoid process, or opening through the tympanic membrane into the middle ear, will prevent the development of a threatened meningitis.

Drugs, like iodid of potassium, salicylate of soda, and digitalis have been given on purely empirical grounds, but there is no evidence that they exercise any real effect on the progress of the disease.

The French physicians (Netter *et al.*) assert that good results follow the systematic use of hot baths, especially in the epidemic form of cerebrospinal fever. If care be taken not to disturb the patient too much in taking him to and from the baths, these can do him no harm, and a trial of them may be recommended.

Treatment by systematically repeated lumbar puncture has received support in various quarters, and a number of authors assert permanent benefit therefrom (Lichthani, Quincke, Osler, Wentworth, Concetti, Traves Smith). If there is reason to believe that the symptoms are largely due to increased intracerebral pressure, puncture may be re-

peated every other day until the process subsides. It does not, however, prevent relapses (Koplik). The technic of lumbar puncture is described under Surgical Treatment. Quincke has recommended slitting up the dura mater, but there have been too few cases treated by this method to permit of any satisfactory judgment concerning its value. Attempts have been made to drain the cavum subarachnoidale, and to flush it out from one end to the other with salt solution or other fluids (Cushing, Rolleston), but not enough cases have been so treated to permit the drawing of conclusions regarding their value. Dazio recommends subcutaneous injections of bichlorid of mercury; why, it is hard to understand.

A suggestion recently made by L. Hektoen of Chicago (1905) is worthy of consideration. In view of the fact that the opsonins of normal blood-serum exert an effect upon bacteria which makes them susceptible to the action of phagocytes, and of the further fact that the normal cerebrospinal fluid is devoid of opsonins, Hektoen suggests that the opsonins poured out in the inflammatory exudate into the meninges be supplemented by injecting normal blood-serum into the subarachnoidal cavity after lumbar puncture. Thus, after removal of 20 to 40 cc. of cerebrospinal fluid and exudate, 10 or 20 cc. of normal blood-serum (preferably human) could be injected through the same canula. The procedure may safely be repeated every other day until the cerebrospinal liquid is clear. If a case should appear where Flexner's antimeningitis serum is not available, this might be tried.

It has occurred to the writer that still another method of treating cerebrospinal meningitis might be cautiously tried. It is well known that an arthritis may be favorably influenced by the production of artificial venous congestion (compression of limb proximal to affected joint). Acute coryza can sometimes be quickly checked by slight compression of the veins of the neck. I think it would be justifiable to put the band of an ordinary blood-pressure apparatus around the neck of a patient suffering from cerebrospinal meningitis; blow air into it until the pressure amounts to 20 or 25 mm. of mercury, and leave in place for one hour at a time. The pressure should be just enough to cause slight lividity of the face, but not enough to cause marked cyanosis or great discomfort. The patient should be closely watched, and if the pulse were slowed much or vomiting excited, the pressure should be removed at once.

The Portuguese recommend lysol injections into the subarachnoid cavity (C. Franca, Seager). Two canulæ are inserted in the lumbar region, one above the other. Salt solution is first injected through the upper canula and allowed to escape through the lower; afterward a few cubic centimeters of 1 per cent. lysol solution are injected, 3 to 9 cc. in a child, 12 to 15 cc. in an adult. Morris Manges[1] has tried this treatment in 3 cases and recommends its further use.

Symptomatic Treatment.—The headache and pain in the head, while often greatly relieved by complete rest and quiet and by the appli-

[1] Med. News, N. Y., May 14, 1904.

cation of ice-bags, very frequently require morphin. This drug should not be withheld when the pain is very severe. It is best administered hypodermically, in doses suited to the age of the individual, repeated as frequently as is necessary to give relief. Irwin has recently revived the systematic opium-morphin treatment of meningitis.

If the vomiting be severe, it may sometimes be relieved by the morphin given for the pain in the head. The vomiting is, as a rule, of central origin, and accordingly remedies locally applied are less apt to give relief than in cases where the irritation is local. Cracked ice by the mouth, however, is sometimes of benefit. If it fails, a mustard plaster over the epigastrium may be tried. More, however, is to be expected from the action of the morphin than from such measures.

In the early stages, where the patient is chilly or suffers from actual rigor, heat should be applied externally. The patient is to be wrapped in warm blankets and hot-water bags applied to the feet.

Where there are convulsions, especially in children, the warm bath is to be recommended, the patient being transferred from the bed to the bath with as little disturbance as possible.

The condition of the bladder should be closely watched, as retention is not infrequent, and expression or aseptic catheterization may be necessary.

In cases which show a tendency to stupor or coma the patient may be placed in a luke-warm bath and cool water may be poured over the head. Some patients, especially with epidemic cerebrospinal fever, do well if given hot baths (37.5° to 40° C.) every four hours.

The skin manifestations of the disease rarely require any special treatment. The erythema, urticaria, or purpura, if it appears, may be neglected. The herpes which often ushers in the disease is not of serious moment in itself, and may be left alone or treated by the application of a little zinc oxid ointment or carbolated vaselin.

In the subacute or chronic cases, especially where there are remissions, diaphoretic treatment may be resorted to, and sometimes appears to yield beneficial results, perhaps by assisting in the elimination of poisons of the blood. Diaphoresis is best produced by repeated hot baths and warm packs. The strength of the patient must, of course, be watched, if such treatment be undertaken.

In the more chronic cases or in convulsions, iodid of potassium or of sodium may be administered, in the hope that the absorption of the meningeal exudate will, through the influence of the iodid, be favored.

The fever, as such, rarely requires special treatment. It is harmful to give acetanilid, antipyrin, and similar remedies. If there be hyperpyrexia it should be met by cool sponging.

Otitis media is perhaps as frequent a complication of cerebrospinal fever as any. Close watch should be kept for its development, and if pus forms the operation of paracentesis of the tympanic membrane should be performed. Too often, spontaneous rupture announces the accumulation of the inflammatory exudate in the middle ear. Following operation or spontaneous rupture, the ear cavity of the

tympanum should be cautiously irrigated with 1:20 boric acid solution, the ear carefully dried and drained with dry gauze; as recovery proceeds a little dry boric powder may be blown into the external auditory canal each day.

If iridochoroiditis or panophthalmitis develops, the help of the ophthalmologic surgeon will be needed.

Great care should be taken to prevent decubitus. The sacral region, the gluteal regions, the calcaneal regions, and the region of the olecranon on each side should be rubbed with alcohol frequently, and protected from pressure by changing the position of the patient and by bandage-supporting rings.

If sinus thrombosis develops secondary to a diffuse meningitis, the outlook is almost hopeless; operation is probably contraindicated. Where the sinus thrombosis is primarily the result of an otitis or mastoiditis, and the meningitis secondary and localized, brilliant results are obtained from surgical interference. Macewen saved 20 out of 27 cases, Jansen 11 out of 24.

In meningitis a large portion of the exudate may, in rare cases, be localized and become encapsulated, so as to form a subdural abscess; the cortex is often involved in the abscess process. As a rule, the existence of a diffuse purulent meningitis is regarded as a contraindication against operation in case of brain abscess. Still, MacEwen, Beck, Gradenigo, and Lucal favor trepanation, as does also Barbarin. If the existence of an abscess can be established and its position localized, the writer would advise operation. The otologist very often has the opportunity to prevent the development of a secondary meningitis by urging prompt operation in certain ear diseases.[1]

A frequent and often serious complication is bronchopneumonia. It may be due to the same microörganism which is responsible for the meningitis or to infection with an entirely different bacterium. Should it develop, an ice-bag may be applied to the affected part of the chest when the pain is severe. At other times the chest should be kept enveloped in a pneumonia jacket. Drug treatment of such a complicating pneumonia is inefficacious, except where it may be indicated for the support of the heart. True lobar pneumonia occasionally complicates cerebrospinal fever. It is to be treated like pneumonia from any other cause (*q. v.*).

Should an acute pleuritis develop as a complication, it is to be met in the ordinary way, as described in the special article in this hand-book dealing with that subject.

Joint affections are common accompaniments of cerebrospinal fever. Any joint may be involved, but the knees, ankles, elbows, and wrists are particularly prone to be affected. As long as the exudate is serous the arthritis may be treated by rest, immobilization, and envelopment of the affected joint in cotton. Should the joint suppurate it must be drained by the surgeon. During convalescence mechanical therapy may become necessary (*q. v.*).

[1] Cf. Friedrich, Deutsche med. Woch., 1904, p. 1167

Endocarditis and pericarditis are less frequent complications of cerebrospinal fever. Should the development of either be suspected an ice-bag should be kept constantly applied to the precordial region. In case the pericardial exudate should become so large as to impede the action of the heart, the sac should be drained. Of course, if the pericardial exudate is purulent, a free opening will be necessary.

Throughout the course of the disease a close watch should be kept upon the eyes, for, aside from the more serious ophthalmic complications already referred to, conjunctivitis and keratitis are prone to occur. The nurse in charge of a patient suffering from cerebrospinal fever will do well to irrigate the eyes morning and evening with boric acid solution (1:20).

The treatment of the sequelæ of cerebrospinal fever is often embarrassing to the physician and calls for great patience and perseverance. The friends of the patient demand that everything possible shall be done to remove a persisting deafness or blindness. Too often, unfortunately, treatment for these symptoms is unavailing. The exact physical condition of the eye or of the ear should, however, be made out by most careful tests; if this be done, a more accurate prophecy can be made than would otherwise be possible. Measures should be taken to build up the general health; in convalescence electricity may be of some service, and small doses of strychnin may be administered. Incoördination in walking, which frequently accompanies deafness as a sequel in young children, often improves a good deal or may even disappear in the course of months or years. Where this ataxia develops the little patient should be gradually subjected to a course of training in coördination, similar to that employed by Fränkel in the treatment of tabes cases. Sweating cures have in late years been recommended for the removal of sequelæ; they have occasionally helped in deafness.

Paraplegia, hemiplegia, or aphasia rarely follow cerebrospinal fever. When they do, they are to be treated according to general principles.

Concerning the special treatment dependent upon the social history, the family history, and the previous medical history of the patient there is but little to be said. The majority of cases of cerebrospinal fever occur in adolescence. The disease, however, may attack people of any age; the very young and the very old are likely to suffer severely when attacked. Sex apparently plays no rôle in the disease. Occupation, in so far as it predisposes by irregularity of habits, exposure to cold, overexertion, fatigue, or excess, is of considerable importance. Thus, in garrisons it has often been noted that young recruits are much more likely to be attacked, and when attacked, to suffer more severely than soldiers who have been in training for some time. The overcrowding of tenements, orphanages, and schools seems to predispose definitely to the disease, and when cases occur in such crowded places it is desirable that the patients should be removed as speedily as possible to large, well-aired rooms in hospitals.

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CHOLERA ASIATICA

By Lewellys F. Barker, M. D.

Asiatic cholera is an *infection of the intestine*, due to the entrance into it of the vibrio choleræ Asiaticæ or so-called comma bacillus of Koch. This bacillus or spirillum was discovered by R. Koch in the year 1883, first in Egypt and later in India, where he demonstrated its presence, not only in the dejecta of a great number of cholera patients and in the intestinal contents of cadavers, but also in the water of a tank, the use of which had been known to cause a large cholera outbreak.

True Asiatic cholera, no matter in what countries or in what persons it occurs, is always due to the vibrio mentioned. Cholera nostras and other infections with symptoms resembling Asiatic cholera are entirely different diseases. The disease occurs naturally, so far as is known, only in human beings, though it can be produced experimentally in animals by changing their conditions (Nikola and Riech, 1884; Koch, 1885; Thomas, 1893). A few drops of a dilution of a cholera culture of 1: 1,000,000, injected into the ear vein of a young rabbit, invariably causes death with typic lesions (Isaeff, Kolle, 1894). The vibrios vary greatly in virulence. Of 60 cultures obtained from Egyptian sources the minimal fatal dose for an experimenal animal varied from $\frac{1}{2}$ to $\frac{1}{2^{10}}$ oese.

Asiatic cholera, aside from epidemic outbreaks, has been produced over and over again in human beings through laboratory infection, intentional or unintentional. R. Pfeiffer, one of the investigators who has made very important contributions to our knowledge of the disease, contracted it in the laboratory in Berlin in 1894, but happily recovered. A year later Dr. Oergel, in Hamburg, became infected from a drop of fluid from the peritoneal cavity of an infected guinea-pig which spurted into his mouth. He sickened the next day and died a few days later in coma. Pettenkoffer and Emmerich, who disbelieved in the bacteriologic origin of cholera, both contracted the disease by swallowing small amounts of cholera cultures along with an alkaline fluid. The former had a mild attack; the latter suffered severely and nearly lost his life.

Human beings contract the disease by taking the vibrios into their stomach, usually in water or on food. If the stomach is in normal condition, and especially if it contains a normal amount of free hydrochloric acid, infection may not occur, as the cholera vibrios are sensitive to hydrochloric acid and are often killed in the stomach. That they do get through, however, is clear from the cases which occur. It is

easy to understand how, if well mixed with food, they might escape the action of the acid, especially if that be for any reason diminished in quantity. The experiments of Ewald show, too, that if fluid, especially cold drinks, be taken upon an empty stomach the stomach may empty itself quickly, and its contents may pass almost directly over into the intestine. Water contaminated by cholera bacilli could thus easily gain entrance to the alkaline duodenum, and once in the intestine, the conditions for the multiplication of the cholera vibrios are very favorable.

The mere entrance of the cholera vibrios into the intestine and their multiplication there, however, do not necessarily bring about a true cholera attack. There are many cases met with in cholera epidemics where patients manifest slight diarrhea and a little abdominal pain, but if they put themselves immediately upon a strict diet and take complete rest no typic cholera attack develops. On the other hand, unless these precautions are taken, and sometimes even when they are taken, a typic cholera attack is likely to occur. It seems certain that the true cholera attack is due to a definite *infection of the epithelium* of the mucous membrane of the intestine with the cholera vibrios, and that anything which lessens the resistance of the epithelial surface, be it trauma, faulty diet, overexercise or what not, may lead to the invasion of the epithelium and the cholera attack. Once the epithelium is invaded and begins to be loosened from the basal membrane and shed, the cholera poison, which is liberated from the bodies of dead cholera bacilli, can be absorbed, and then the typic cholera attack occurs.

Of the highest importance for the understanding of the disease is the knowledge which we have gained regarding the nature of the cholera poison. The earlier idea of Hueppe (later supported by Gruber and Wiener), according to which the cholera toxin is like the diphtheria toxin, a soluble secretion product, has been given up. It has been definitely shown by R. Pfeiffer that the cholera vibrio yields no secretion which is capable of producing on injection the symptoms of cholera. On the other hand, the bodies of the cholera vibrios when cautiously killed have been found to be extremely poisonous, and to cause death in experimental animals with the production of phenomena similar to those occurring in the typic human cholera attack, including paralysis of the centers of circulation and of heat regulation. It has been impossible thus far to secure this poison in a pure state.

Cholera is endemic in parts of Asia, but from time to time makes excursions into western countries. It occurs in two forms of epidemics—the so-called "contact epidemics" and the "explosive or water-supply" epidemics. In the contact epidemics the disease begins with individual cases and the epidemic progresses in a slow, sneaking fashion, passing from individual to individual through contact. The water-supply epidemics are usually large outbreaks, great numbers of people being simultaneously stricken with the disease, owing to contamination of the water supply with the dejecta of the cholera patients. The Hamburg-Altona epidemic is a remarkable example of the distribution of the disease according to the water supply. On one side of a street, which

obtained its water from the contaminated supply, great numbers of cholera cases developed; on the other side of the street, where water was obtained from a pure source, the only cases which developed were in individuals who had drunk water elsewhere or who had come in contact with diseased individuals. An epidemic may begin as a contact epidemic, and then suddenly, through the pollution of the water supply, become transformed into a large water-supply epidemic.

Cholera may occur at any time of the year, though it is more common in the summer and autumn than in the winter. It attacks people of all ages and of all races, but people who are in vigorous health, who are cleanly in their habits, and who live in good hygienic surroundings, are far less likely to be attacked during an epidemic than those who for any reason are debilitated, who live in crowded tenements, who cannot secure sufficient well-prepared food, who through habit or necessity are unable to obey the hygienic laws which keep the body in a good condition of resistance. Infants and old people suffer more than the adolescent and middle aged. Errors in diet and sudden chilling of the body are specially prone to lower the resistance of the intestinal epithelium, and must be strictly avoided in cholera times. Cholera is by no means a contagious disease, in the sense in which small-pox and scarlet fever are contagious diseases; indeed, a well-educated person, knowing the source of the cholera vibrios and knowing that the portal of entry in human beings is practically always the mouth, can absolutely protect himself from an attack of cholera by preventing the access of the vibrios to his stomach. If he keeps his hands clean, and if he takes no food or water that is not strictly sterile in cholera times, he will not be infected. Physicians and nurses, working among cholera patients and taking suitable precautions, do not contract the disease.

The cholera poison is to be regarded as an *endotoxin* rather than as a toxin in the ordinary sense (Cantani, R. Pfeiffer). It has not been possible to build an antitoxin for it, such as can be made for the diphtheria toxin, the latter being a toxin in the ordinary sense and not an endotoxin. The serum of animals immunized with living or dead cholera cultures contains immune bodies (amboceptors), which increase markedly the power of the serum to dissolve living or dead cholera vibrios; in other words, the bacteriolytic power of the serum for cholera vibrios is increased.

The endotoxins of the cholera vibrios differ from toxins of diphtheria or tetanus further in the fact that they do not require an incubation period before acting, but produce their poisonous effects with great rapidity on absorption. The poisonous effect, however, is much more transitory than in the case of diphtheria or of tetanus. Apparently the uninjured intestinal epithelium prevents the absorption of the endotoxins of the cholera vibrio. It is only after necrosis and desquamation of the surface epithelium that the endotoxin is absorbed and produces its effects. This explains why the severity of the symptoms corresponds to the extent of mucous membrane involved, for the more rapidly the poison is absorbed the more severe are the symptoms. The endo-

toxins of the cholera vibrios exert a definite effect upon the circulatory and thermoregulatory apparatus, and this effect is the same in experimental animals, whether the poison is absorbed from the intestine or from the peritoneal cavity or injected intravenously.

As regards the *mode of transmission* of the vibrio, the following statements may be made: It is known that the vibrios leave the bodies of infected persons chiefly in the dejecta of the first two days of the disease. Occasionally they are present in the vomit, but, as a rule, they are confined to the stools. The vibrios are spread, then, directly by means of the dejecta or by objects contaminated by the stools, such as bed-linen, body-linen, vessels, the floor, closets, earth upon which dejecta are thrown, spring water contaminated by surface drainage, etc. The more objects contaminated by the dejecta the greater the number of sources of possible infection and accordingly the greater danger of spreading. Fortunately for human beings, the cholera vibrios are killed by drying, so that contaminations are, in most instances, speedily rendered sterile. Even on moist objects the vibrios ordinarily retain their vitality for only a short time—probably only for a few days, since they are easily overrun by saprophytic bacteria of various sorts. They may, however, under peculiarly favorable circumstances, retain their vitality in moist places for several weeks.

As far as we know the *natural mode of infection* is by the mouth. In some way or another the vibrios are transmitted from the dejecta of the patient suffering from Asiatic cholera to every individual who becomes infected. From what we have said concerning sterilization by drying, it will be easily understood that the air plays but little, if any, part in the distribution of living vibrios, since only dry particles are carried for any considerable distance in the air, and dry particles can contain only dead cholera vibrios. It is conceivable, of course, that the air may act as a medium of distribution in a few rare instances, as, for example, when actual spray from infected fluids is carried by the wind. Thus, it has been suggested that the spray from waves beating upon a wharf, or from the wheels of a water-power mill, or from the wash-tub in which cholera infected linen is immersed, might be responsible for the transmission of the disease to people in the immediate neighborhood. But practically the air may be eliminated as a carrying agent. Infection by direct or indirect contact is, then, the real method of transfer. Either the dejecta themselves, or objects contaminated by the dejecta directly or indirectly, bring the bacilli to the mouth. Untrained attendants, especially if they be uncleanly, easily carry the vibrios on their hands, under the finger nails, or upon their coat sleeves, whence within a few hours they may be transferred alive, quite unintentionally and unconsciously, to their mouths. Probably a still more frequent mode of transfer is from contaminated fingers or contaminated objects to food. Human beings are not alone responsible for this, but insects of various sorts, especially flies, may carry the vibrios to the food. Once on the food they may multiply with great rapidity before the food is eaten.

But by far the most important medium for transferring the vibrios from the dejecta to the portal of entry of the patient to be infected is ordinary water, either that used for drinking or for the preparation of food—especially salads—or for the washing of dishes upon which food is to be served. It has been to the contamination of wells, springs, reservoirs, canals, and rivers that all large outbreaks of cholera have been due. This was long suspected from the distribution of infected cases, but in recent times it has been possible to demonstrate the actual presence of the cholera bacilli in the water drunk by the people infected.

The Course and Tendencies of the Disease.—It is customary to divide the disease process in cholera into three stages: First, a *prodromal stage*, or stage of preliminary diarrhea; second, the *stage of the true cholera attack;* and third, the *stadium algidum* in fatal cases, or the *stadium restitutionis* in cases that are to recover. In the prodromal stage the cholera vibrios supplant the intestinal flora and multiply within the intestinal lumen. This stage may be unaccompanied by severe symptoms, the patient complaining only of slight diarrhea and perhaps some abdominal uneasiness. When the intestinal epithelium becomes invaded by cholera vibrios, and the epithelial cells become necrotic and begin to be shed, the true cholera attack develops; the rice-water stools appear, and the depression of the circulation and the interference with the thermoregulatory centers become noticeable. The rice-water stools are due to the enormous transudation of fluid into the intestines and the separation of groups of epithelial cells. The shedding of the epithelium permits the absorption of the endotoxins of the cholera vibrios, and through the blood they exercise their paralyzing effect upon the centers mentioned.

In cases that die the stadium algidum follows. There is complete collapse, profound intoxication, often coma and death. If recovery is to take place, the symptoms gradually ameliorate, the urine increases in amount, the fever of reaction sets in, and convalescence soon becomes established.

Bacteriologic studies of the disease have explained the various *anomalous cases* which may be met with. The fact that some healthy persons, in cholera times, have large numbers of cholera vibrios in their intestines, without presenting any symptoms of the disease, proves the existence of a high degree of natural immunity in certain cases. Experience has shown that out of a group of ten persons exposed to infection only one or two die, two or three more suffer intensely from the disease, and the rest experience only slight attacks or have no disturbance whatever. Individuals with good mechanisms of defense in the intestine constitute the so-called abortive cases. Now and then the invasion of the epithelium by vibrios, its desquamation, and the consequent absorption of the endotoxins of the vibrios occurs with such rapidity that death takes place within a few hours after the onset of the first symptoms, and before the intestine has had time to expel the rice-water stools. These are the so-called cases of *cholera sicca*. In a good

many cases, after the cholera vibrios have injured the mucous membrane of the intestine, they become overrun by other forms of bacteria in the intestine; the latter give rise to extensive inflammations, sometimes of a croupous character, with resulting extensive lesions of the intestinal wall. Poisons other than the cholera poisons then become absorbed, and the patient enters the so-called status typhosus. Such cases are known as *cholera typhoid.*

Among the *complications* met with in Asiatic cholera may be mentioned cholera nephritis, various skin eruptions, furunculosis, gangrenous processes, croupous inflammations of the mouth, pharynx, stomach, intestine, gall-bladder, larynx, bladder, uterus, or vagina, due usually to secondary infection with pyogenic microörganisms, and hemorrhage into the skin and internal organs. Pneumonia may occur, either lobar or lobular in form. Infarction of the lung, of the spleen, or of the kidneys is not uncommon. Complicating pleurisy, peritonitis, or meningitis may be met with. Septicemic and pyemic conditions may be superimposed, abscesses appearing in the connective tissue, in the lymph glands, in the muscles, or in various internal organs. Thromboses of the veins sometimes occur. Sequelæ are not so common as one might expect, considering the gravity of the affection. Most cases get quite well if they recover at all. The cholera typhoid, if it be regarded as a sequel, is the gravest of all, but is more properly classed among the complications of the disease. It is perhaps not surprising that a good many cases for a long time after recovery have weak digestive functions and a tendency to diarrhea or to constipation. In some instances the general metabolism of the patient seems to have been deleteriously influenced by the cholera infection, and the patient for a long time remains emaciated, anemic, and feeble. In rare instances progressive marasmus follows upon the infection. Psychoses may develop during convalescence; melancholia is the form most often met with. Inebriates frequently develop delirium tremens as a result of a cholera attack.

Mortality and Cause of Death.—Next to bubonic plague, cholera is the most fatal of the diseases which occur in large epidemics. Approximately half of all people attacked die of the disease. Statistics are notoriously unreliable, however, in this disease on account of the impossibility of including in them the large number of cases of slight infection which are not diagnosed. The mortality has been found to be higher in the early part of the epidemic than it is later on, the most susceptible individuals probably being attacked first. The mortality differs somewhat in different epidemics, owing partly in all probability to differences in virulence of the vibrios and partly to differences in resistance, at the time, of the people attacked. The majority of deaths occur within forty-eight hours after the onset. Many die later, especially if symptoms of cholera typhoid complicate the infection. If coma develops, especially if it be not preceded by fever, death is almost certain to follow. The mortality among children is very great. Under ten years the younger the child, the more unfavorable the prognosis. Over fifty years, the older the individual the more likely he is to

die. Sex does not influence the mortality. Individuals depleted by chronic disease, by an irregular life, or by poverty and hunger, suffer more than the healthy and well nourished.

Main Objects of Treatment.—The whole secret of success with cholera lies in prevention. Nearly all medical effort should be devoted to the preventing of the individual cholera case through prophylactic measures. It is improbable that the disease will ever run rampant in this country. Bacteriology has made it possible for us to prevent epidemics of cholera, and any nation which permits them to develop has itself to blame. When an individual is once attacked by cholera bacilli, the main object of treatment is to prevent invasion of the intestinal epithelium by adequate treatment of the preliminary diarrhea. Once the epithelium is invaded, we may direct our effort toward supporting the strength of the patient until the infection runs its course. A successful specific therapy has not yet been worked out, but progress in immunization experiments is making so rapidly that much may be hoped for in the future. The fact that men who have had cholera and have recovered from it are immune from a subsequent attack, will encourage investigators to discover the basis of this immunity, and to use their knowledge for inventing a curative remedy.

TREATMENT

The whole cholera question, as has been said, resolves itself largely into a matter of *prophylaxis.* Modern cholera prophylaxis is a triumph of the bacteriologic era. Cholera still kills about half the people attacked, but by proper prophylaxis very few people need be attacked. Endemic in Asia, western civilization has for centuries tried by strict *quarantine* to prevent the introduction of the disease from the East. If quarantine is strict enough, and is kept up for a long enough time, it will undoubtedly prevent the importation of the disease, but the experience of our ancestors proved that quarantine, except in a very few instances, can rarely be enforced with sufficient rigor to prevent the disease from slipping through. Moreover, long detention at quarantine —a detention of weeks and months, such as was formerly enforced— is incompatible with modern civilization and with the exigencies of present-day commerce; the short quarantine periods feasible now-a-days—periods of a few days, for instance—are totally insufficient to keep out cholera, since it has been definitely proved that cholera bacilli may remain numerous and virulent in the intestines of apparently healthy people not only for weeks, but for nearly two months. The control of international travel and trade, therefore, by military cordons and by wearisome quarantine has undergone great modification. These expensive and, for the most part, useless methods have been abandoned, and freedom of transport for passengers and effects is permitted. The world recognizes that enormous sacrifices, such as were formerly required, are not justified by the results they yield. (See article on Plague in this hand-book.) The International Congress for Sanitation,

held at Dresden in 1893, wisely decided to remove all unnecessary hindrances to travel and trade. This, of course, does not mean that no supervision of international communication is required. On the contrary, when cholera is known to exist at a given port or in a given city, vessels or railway trains therefrom should be closely examined for cholera suspects. Similarly, it is of importance for all Mediterranean ports that there be some supervision of the pilgrims who return from Mecca, since it is well known that the hordes of Mahommedans gathering there from all parts of the East have in the past been significant factors in the spread of cholera. The establishment of an examining station at Alexandria is, therefore, important as a protection to seaports in all parts of the world.

Far more important than the restriction of international travel and commerce is the *development of a rational prophylactic system within the confines of each country*. Germany has set a magnificent example in this regard, and has shown by its experience since 1892 how efficient such a system can be. Despite the great outbreak at Hamburg, where some 9000 people died in one epidemic, there have been, since 1892, less than 10,000 deaths in all Germany from cholera Asiatica, whereas in Russia, during the same period, some 800,000 deaths from cholera have been reported. Germany, better than most countries, can enforce such an intranational prophylactic system, for it has the advantages of highly trained bacteriologists in charge of the work, a most efficient police system, and a populace which has tremendous respect for public authority. It is very doubtful indeed if under present conditions in America as good results could be obtained as in Germany. Still, should cholera visit these shores the experience of Germany affords an example than which there is no better to follow.

The backbone of intranational cholera prophylaxis is the *prompt bacteriologic diagnosis*. By this must be understood not only the rapid bacteriologic examination of the dejecta of every patient who has cholera, but also of all suspects, all exposed individuals, all contaminated surroundings, including, especially, the water supply. It is the immediate recognition of the cholera case as such when it occurs which permits the prevention of the spread of the disease, for if each case entering a country or appearing in a country be rendered harmless by suitable isolation and disinfection the disease cannot spread.

In cholera times every case of diarrhea should be regarded as a cholera suspect, and, pending the bacteriologic diagnosis, should be treated as such. Fortunately, a well-disciplined bacteriologist can, by modern methods, come to a positive decision as to the existence or non-existence of cholera in a given case within twenty-four hours. With the aid of the Koch-Dunbar peptone method, combined with cultures of agar plates and identification by the agglutination test, it is easily possible to decide definitely as to the presence or absence of the cholera vibrios. If the cholera vibrio is found, then prompt isolation should be enforced and disinfective measures should be undertaken.

It is obvious that for the immediate recognition of cholera cases a

rigid system of reports must be in vogue. A grave responsibility rests upon every physician in cholera times, lest he allow a possible case of cholera to go unreported to the local health authorities and so pass unrecognized. Every case, no matter how slight the symptoms, should be investigated at once.

The successful management of a cholera outbreak requires the best skill of bacteriologists especially trained in cholera diagnosis. Should cholera appear in America, the best bacteriologists within reach should be called upon immediately to take control, and, should there be any spread of the disease, every local health board should see to it that it has at least one man who has been especially disciplined in the methods of cholera diagnosis. Bacteriologic laboratories should immediately institute *courses in cholera diagnosis*, and representatives from the health boards should, if they have not already received such training, repair at once to the bacteriologic laboratory for instruction.

In case cholera, through delayed recognition or inefficient protective measures, begins to spread, either as a contact epidemic or as an explosive water-supply epidemic, a *commission for fighting cholera* should at once be formed in the locality in which the epidemic occurs, and this commission should consist not only of the health authorities, but of the most intelligent laymen and best-known business men in addition to physicians. At the head of it, and with real control, should be a modern bacteriologically trained hygienist. The activities of such a combined commission will be much more efficient than any health board acting without the coöperation of the laity.

As soon as the diagnosis of cholera in a given case has been established by bacteriologic methods, arrangements must be made for the continuance of the *isolation* of the patient. All persons who have been in communication with the patient shortly before the attack must be kept under strict medical supervision for at least five days, preferably in a detention hospital. The dwelling and the effects of the patient should be carefully disinfected by a corps of disinfectors especially trained in cholera work, for *cholera disinfection* is very different from ordinary disinfection, the important thing being to sterilize everything that could have come in contact in any way with the dejecta of the patient. Air contamination is not to be feared. Contact contamination, on the other hand, is what is to be looked out for.

Once cholera is within the boundaries of a country, the greatest care must be exercised in the *supervision of harbors, rivers, and streams*. This is best done by the establishment of so-called *cholera stations*, which keep a close watch over shipping and navigation. There should be a daily control of all boats and crews entering the harbors or passing through the rivers or canals. This supervision can be efficient without seriously interfering with commerce, and its usefulness in preventing the spread of cholera was made very evident in Germany in 1892. Aside from the inspection of the boats and their crews, such control stations can do much by prohibiting the use on all vessels of any water for drinking purposes other than that from a pure supply. It is by no

means uncommon for the crews of river boats especially to draw their water supply from the river itself. Indeed, the great Hamburg epidemic developed very gradually about the harbor among people who used the harbor water for various purposes. The disease spread slowly at first, and then suddenly later broke out with explosive violence in the whole part of the city where the population drank from a certain water supply. Altona, really a part of the same city, though supplied with different water, was free from the disease except for a few cases, and these were individuals who could be shown to have been working in places where they drank from the Hamburg supply.

The *systematic control of the water supply*, then, is the best method of avoiding great cholera epidemics—the so-called explosive outbreak. If the water supply is obtained by filtration, every individual public filter should be subjected daily in cholera times to bacteriologic control. The number of bacteria passing through should be estimated in order to ascertain whether or not the filtration-plant is properly performing its functions. Moreover, even when the water is filtered the source of the crude water should be carefully protected and contamination by cholera dejecta should, so far as possible, be prevented. In America a great many water supplies are very inadequately protected, and one shudders to think what might happen if, for instance, a cholera patient should contaminate the water of Lake Michigan in Chicago harbor, or another, on a Mississippi steamer, should pollute the waters of the river just above the St. Louis intake. America is far behind some other countries in taking advantage of the means of preserving public health which modern science has placed at our disposal. It is to be hoped that American cities will not wait until they are too severely punished before instituting the sanitary measures, especially in the form of adequate filtration-plants for water supplies which have been shown by pathology and bacteriology to be essential for the safety of their inhabitants.

It should not be forgotten that springs and wells may be easily contaminated by the cholera vibrios at times of cholera visitation. These should be well watched by sanitary officials, and if suspected should be closed immediately and controlled bacteriologically. It may at times be necessary to sink artesian wells to temporarily provide a safe water supply.

The supervision of railway trains and highroads is of less importance. Naturally there should be a watch upon trains and vehicles coming from infected towns, but it must not be forgotten that mild cases will scarcely be recognized even by the strictest medical examination. Pedestrians coming in from infected towns and villages may bring the disease with them, and it is, therefore, of importance to observe closely the inmates of hotels and lodging-houses.

As far as *individual prophylaxis* is concerned, the measures consist, in the first place, of making sure that no unsterilized object enters the mouth during the period of cholera visitation. If fingers and handkerchiefs do not reach the mouth; if the water drunk and the food eaten

be sterilized by boiling or cooking, and the dishes in which they are served have not been contaminated, the individual will not contract cholera. It is not possible, however, for every individual to make sure that these precautionary measures have been complied with. It is, therefore, important during cholera times to make sure that the natural mechanisms of defense in the body are in good order. Every effort should be made to prevent disturbances of digestion, and the general health should be maintained at the highest possible level. Excesses of all sorts should be avoided, especially excesses in eating and drinking. In cholera times the largest number of cases develop on Mondays and Tuesdays, as a result of Sunday's feasting and irregularities. Meals should never be large, and they should always be eaten slowly. Cold drinks, and any food or drink increasing the peristaltic activity of the stomach, and so lessening the time for the action of the acid of the gastric juice upon the gastric contents, should be avoided. No raw fruits or uncooked vegetables should be taken. Beer and alcoholic excess of all sorts should be avoided particularly. *The slightest tendency to diarrhea in cholera times should be regarded always as very serious, and the individual should immediately go to bed and be treated as though he were suffering from the preliminary diarrhea of cholera* (*vide infra*). Were this advice always followed a large proportion of the cases which die from cholera would be saved.

The production of a specific immunity against cholera for the individual may well be considered in cholera countries and at times of cholera visitation in all countries. Immunity against cholera can be developed in experimental animals and in human beings (Brieger and Wassermann, Haffkine, Kolle). It is an active or bacteriologic immunity and not a passive or antitoxic immunity (Pfeiffer). It is an immunity called forth through the action of substances contained within the bodies of the cholera vibrios on the cells of the human body. The immunity substances are not altered bacterial substances, but are products of cell metabolism, the result of a biologic reaction of the tissues of the body to the influence of the proteins of the cholera vibrios. A surprisingly small amount of bacterial substance can give rise to a very large amount of immunity substance; for instance, 0.004 mg. of bacterial substance will, in experimental animals, produce enough immunity substance in the serum to dissolve up 300,000,000 times that weight of living cholera vibrios. The immunity substance which acts thus bacteriolytically is of the nature of an amboceptor, which connects the complement of the serum to the bacterial cell (Ehrlich). Normal blood-serum has a bacteriolytic effect upon cholera bacilli, but the speed of the bacteriolytic process is greatly accelerated by immune serum. Haffkine's protective inoculation against cholera is a vaccination first with vibrios of feeble virulence and later with virulent vibrios. By the injection subcutaneously of dead cholera bacilli Kolle produces an active bacteriolytic immunity which lasts several months, or, in other words, longer than any given cholera epidemic is likely to continue. The use of prophylactic inoculations of autolyzed vibrios, worked out by R. P.

Strong of Manila, may yield better results than either Haffkine's or Kolle's procedure.

The conditions in India have permitted an extensive test of Haffkine's prophylactic. According to Haffkine, the statistics show very definite protection from the fifth to the two hundred and nineteenth day after inoculation. *The protection is, however, only against infection; if an inoculated person once develops the disease, he is just as likely to die as one who has not received the prophylactic inoculation.* This experience is wholly in accord with the view that cholera-immunity is an anti-infectious, not an antitoxic, immunity. The use of a Haffkine, a Kolle, or a Strong inoculation after cholera symptoms have appeared would not only not be useful, but would be actually harmful.

Passive immunization against infection can be produced in experimental animals by the injection of immune serum. It is of very short duration—much like the passive immunization in plague. This serum is of no value as a therapeutic agent; indeed, it could only do harm if administered after cholera symptoms have appeared. It has no antitoxic powers. Attempts to make an antitoxic therapeutic serum for cholera (Ransom, Metchnikoff, Roux, and Taurelli-Salimbeni) have failed; indeed, there is no likelihood that one will be produced. More hope lies in other directions.

Passing now to a discussion of the treatment of the disease itself, it is necessary to confess that therapy has no such brilliant results to report as prophylaxis can lay claim to. Once the bacteria are in the intestine and have begun to multiply, the most important treatment consists in an effort to prevent or to limit the invasion of the intestinal epithelium—in other words, by suitable treatment of the preliminary diarrhea to *avoid the cholera attack*. It is at this stage of the disease that therapy may be of the highest importance. Indeed, a large proportion of the cases can be definitely cured if they are properly cared for at this time. This is why in cholera times every case of diarrhea, no matter what its origin, no matter how simple it seems, no matter whether the patient has pain or not, should be treated as though it were the beginning of Asiatic cholera. The patient should go to bed; should cover himself warmly and take some warm drink (peppermint tea or hot lemonade without sugar) until he begins to perspire freely. Hot applications may be made to the abdomen (flaxseed poultices or, better, turpentine stupes). Opium should be given at once in small and frequently repeated doses. It may be given as Dover's powders or as paregoric or in the form of tinctura opii. The diet should be immediately restricted. No solid food should be taken. For twenty-four hours it is best to give only hot barley gruel and hot weak tea.

Several cholera remedies have long been in use. The successful ones contain opium. The pil. plumbi cum opii of the Pharmacopœia is a satisfactory mode of administration. A mixture which has been very popular consists of bicarbonate of soda, tincture of opium, tincture of nux vomica, peppermint water, and sugar. Another, a so-called "cholera drops," has the following formula:

℞ Tincturæ opii..... 6 parts.
Vini ipecacuanhæ..... 4 "
Tincturæ ether valerianæ..... 12 "
Olei menthæ piperitæ..... 1 "
Of this 15 to 25 drops are given every half-hour.

Should the diarrhea continue, it is advisable to give a mercurial purgative, say, frequently repeated small doses of calomel or gray powder until typic mercurial stools have followed. Then the opium treatment may be resumed; it may be well to give morphin hypodermically instead of opium by the mouth. The use of intestinal antiseptics has been discontinued. Nearly everything that one could think of of the sort has been tried and abandoned. The attempt, on the face of it, is absurd. Bismuth preparations and salol may possibly have some value.

In case the above treatment of the cholera diarrhea should not be effective, the diarrhea persisting and being accompanied by vomiting, the chances of avoiding the outspoken cholera attack are not good. Irrigation of the colon with from 1 to 2 liters of warm tannin solution (1 per cent.), to which 30 drops of tincture of opium have been added, two or three times a day, has been helpful in some cases (Cantani's "hot tannin enteroclysis"). Attempts have been made by using pressure to force the fluid above the ileocecal valve, some enthusiasts even going so far as to assert that they have washed out not only the small intestines but also the stomach, forcing the fluid out through the mouth!

When the real cholera attack develops, there is a sudden aggravation of the diarrhea, the stools become extremely thin and abundant without pain or tenesmus, and assume the typic rice-water character, the vomiting is obstinate, the general appearance of the patient becomes characteristic, the skin sunken and wrinkled, the nose sharp and the zygomatic bones prominent, the circulation becomes depressed, the secretion of urine is abolished, and the cholera hoarseness appears; there is little left to do then but to treat the individual symptoms. By this time there is undoubtedly invasion of the intestinal epithelium, and dying or dead cholera vibrios have become dissolved and their endotoxins have been absorbed into the circulation.

A rational treatment at this stage would consist either in preventing the solution of cholera bacilli and their absorption, or in neutralizing the endotoxins, or in protecting the cells against their influence. Thus far, unfortunately, we have not been provided with a method which does any of these things. Possibly the bacteriolysis might be to a certain extent slowed by the administration of calcium chlorid or other salts, since Hektoen and his pupils have demonstrated the inhibiting effect of this substance on bacteriolysis *in vitro*, but thus far we have no experience in actual cholera cases to guide us in this matter. Nor has any antidote to the endotoxin, as such, yet been found. Indeed, the body does not appear to prepare such an antidote even in the progress of natural cure. The endotoxins differ from ordinary toxins in that they give rise, by way of the pathologic reaction which they produce, to only bacteriolysins, agglutinins, precipitins, and antihemolysins, and not to antitoxins.

Something may perhaps be done in the way of helping the elimination of the poison. Doubtless the great transudation into the intestine and the copious watery stools represent an important natural means of elimination. The anuria and the cold skin prevent any very extensive elimination by the kidneys or sweat glands. The skin may be kept warm by the use of warm baths, beginning at 35° C. and gradually increasing the temperature to 40° C., each bath lasting about fifteen minutes. The patient may then be replaced in bed and warmly covered to favor sweating. At the same time, to counteract the great loss of water from the intestine and the thickening of the blood, saline infusions may be administered subcutaneously in the infraclavicular regions or into the thighs. It might be worth while to add some calcium chlorid to the ordinary salt solution, in the hope that bacteriolysis may be restrained, for, according to present views, the more rapid the bacteriolysis the more acute and the more severe the poisoning. Instead of subcutaneous infusion, intravenous infusions (into the V. saphena magna above the medial malleolus) may be employed. The immediate effects of intravenous infusions are more striking than those of subcutaneous ones, but, in the long run, subcutaneous infusions seem to have acted better in the great epidemics than the intravenous.

Symptomatic Treatment.—The *vomiting* is often difficult to control. Hypodermics of morphin are as efficacious as anything. A mustard plaster may be applied to the epigastrium. Cracked ice may be freely sucked by the patient. Lavage of the stomach with hot water has been recommended where the vomiting is very obstinate. Some authors recommend small doses of cocain, but it should be used most cautiously, if at all, on account of its depressant effects.

The *rice-water stools* are very weakening, but probably represent an effort on the part of the body to rid itself of the cholera poison. The tannin enteroclysis will help in this. We have already referred to the counteraction of the thickening of the blood by subcutaneous saline infusions.

For the *collapse*, the patient should be wrapped up warm, and surrounded by carefully protected hot bottles. Friction may be applied to the skin. Stimulants should be freely used in case the heart weakens; saline infusions, strong coffee, hypodermics of camphor, ether, or musk may be resorted to.

The *cholera-typhoid* calls for stimulants; it is to be treated like the *status typhosus* in other acute infectious diseases.

In case nephritis develops, greater care than ever should be taken that the patient does not become chilled. Pneumonia and pleurisy are rare complications, which are to be met in the ordinary manner should they develop. If suppurative parotitis occur, and this is not uncommon, the abscess should be opened and drained. If signs of local lividity appear in the extremities, the part should be wrapped in cotton-batting, and the circulation kept as vigorous as possible in the hope that local gangrene may not occur.

In convalescence a non-irritating liquid diet should be kept up for

some time. Only gradually should simple solids be allowed. Indigestible articles of all kinds should be carefully avoided for months after an attack.

Where there is marked emaciation after cholera, the digestive organs must be especially nursed and coaxed. Milk and eggs must be chiefly relied upon; it may be necessary to pancreatize the milk for a time.

Prophylaxis, important for all, is of the highest importance for the very young and the very old, since the disease is more often fatal in them than in the middle aged.

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PLAGUE

By Lewellys F. Barker, M. D.

Plague is an acute infectious disease, due to the entrance of the *bacillus pestis* into a more or less susceptible body in which the bacillus multiplies; the bacilli produce poisons (toxins) as a result of their metabolic activity, and besides, and more especially, the disintegrating bodies of the bacilli which are killed set free certain highly noxious intrabacterial substances (endotoxins); the symptoms are due to the action of these toxins and endotoxins and the reaction of the cells and juices of the body to them. A very large proportion of the individuals attacked die of the disease; it is the most fatal of all the diseases that occur in large epidemics.

Among animals, some rodents are very susceptible to plague, especially guinea-pigs and rats. The gray monkey is almost as susceptible as the rat, mice rather less so. Rats are tolerably susceptible, and may develop the disease spontaneously. The same is true of squirrels. Dogs, pigs, cattle, horses, sheep, and goats may be infected with large doses of bacilli, but, being but little susceptible, recover. Birds are immune.

Plague appears to be endemic in at least four centers: (1) Yünnan; (2) Himalayan slope; (3) Assir; (4) Uganda. The disease is probably kept up in these endemic centers by the rats chiefly, men being occasionally attacked. In Mongolia the disease is epidemic in late summer among the marmots (arctomys bobac), animals closely resembling our woodchuck, and men are easily infected by contact with the cadavers of marmots that have succumbed.

Epidemics of plague in human beings begin slowly and most insidiously; the disease has often gone unrecognized for weeks and months at the beginning of an epidemic. At the acme great numbers are almost simultaneously affected. Then the epidemic very gradually declines.

Plague is *a disease of dirt, damp, and poverty.* Certain unsanitary houses are plague centers whence the disease slowly spreads. Europeans in India and China are rarely affected, even when an epidemic is raging. Plague may occur at any time of year, in any latitude, and at any altitude. *The disease is spread through human intercourse, on the one hand, and through rats (and possibly other infected animals) on the other.* The bacillus enters the human body through the skin or one

of the mucous membranes; it may be inhaled and gain entrance through the respiratory tract. The bacilli may be transferred directly from the sputum, urine, or feces of an infected human being to another individual, or it may be transferred indirectly by soiled linen, clothing, utensils, or contaminated dwellings. The latter method seems to have been common in the Chinatown epidemic in San Francisco, studied by Flexner, Novy, and the writer. Single cases occurred there at intervals, often, of several weeks.

Great epidemics among human beings have frequently been preceded by an epidemic among rats (Hong Kong, Bombay). Rats eat their dead, and this probably accounts for the very rapid spread of rat epidemics. As Dieudonné and others have pointed out, *plague-stricken rats and rats dead of plague are a far greater menace to a community than are cases of bubonic plague in human beings.* Ships from the Orient, free from human plague, may carry rats infected with plague (Hamburg and Bristol, 1901). Rats may swim to shore from a ship and infect other rats and human beings in a seaport. Mice, though less susceptible to plague than rats, may spread the disease (Formosa, 1896; Sydney, 1900). The urine and feces of infected rats may contain the plague bacilli; if deposited in dark moist places these bacilli may live and retain their virulence for a long time. Fleas, flies, and gnats may ingest plague bacilli and pass them in the feces still living and virulent. Some have supposed that the disease may be transferred from rats to man by the bite of a flea or a louse. Against this view is the fact that each animal species has its own particular species of flea. The rat-flea is quite different from the human flea (Galli valerio), and a rat-flea will not bite a human being, it is said, even if kept hungry. Fleas, flies, and gnats may transfer the disease from man to man, not by the bite directly so often as by infection of a bite or a scratch wound through the intestinal contents of the insect when crushed by a slap or while scratching. Flies may carry plague bacilli from plague-sputum, plague-feces, or urine, to the skin, to food, to utensils, or to clothing. Within soiled clothing, plague bacilli may live for months. Grain may be contaminated by rats.

There are *two main types of plague*—(1) *the bubonic* and (2) *plague-pneumonia.* In the former, the portal of entry is the skin or a mucous membrane. As a rule, there is no lesion at the portal of entry and no lymphangitis between this and the bubo, though occasionally a plague vesicle, furuncle, or carbuncle develops (cutaneous plague); the swollen lymph-glands (buboes) give a clue to the part of the body through which the bacillus has gained entrance. Men most often have inguinal buboes (infection of bare feet and legs or genitals), women often axillary buboes (infection of hands or bare arms), children often cervical buboes (mouth infection). In primary plague-pneumonia infection occurs by inhalation in all probability. In bubonic plague or in plague-pneumonia a plague-septicemia (blood infection) may develop. At the beginning and end of an epidemic abortive cases of plague occur (*pestis minor*, ambulatory plague), many of which go unrecognized. There is no convincing

evidence that intestinal plague with mesenteric buboes occurs in human beings.

The Course and Tendencies of the Disease.—The disease ordinarily develops with great rapidity. The temperature quickly rises, sometimes with a chill. The patient suffers from violent headache, pain in the back, and general weakness. The appetite is lost, and there is often nausea and vomiting. Severe vertigo appears, and the patient may stagger as though drunk before he is compelled to remain in bed. All forms of the disease are characterized by extreme cardiac weakness. The pulse is rapid, the tension low. The patient tends soon to become somnolent and delirious. Almost coincident with the rise of temperature, swelling and tenderness of a group of lymph-glands appears. Indeed, a bubo may be almost the first thing noticed by the patient. The spleen becomes palpable by the second or third day; the urine is concentrated and often albuminous.

The *bubonic form* of the cases with inguinal bubo are relatively mildest, those with tonsillar or cervical bubo relatively most severe, having the added danger of tracheal compression and edema of the glottis. Hemorrhages into the skin and mucous membranes frequently occur. In Hong Kong, where the Chinese physicians pinch the skin at various spots on the trunk as a therapeutic measure, I have seen great subcutaneous hemorrhages develop. Death may occur at any stage of the disease, most often, however, on the third, fourth or fifth day. In cases which recover the individual symptoms gradually grow less marked; convalescence may begin anywhere from the beginning of the second to the end of the fourth week. Most fatal cases terminate before the sixth day. Convalescence is frequently a protracted process lasting months.

Plague-pneumonia begins with chill, followed by fever, headache, vertigo, and pains in the legs. The signs of pneumonia develop; the respirations may be increased to 60 or 70 per minute, the pulse is rapid; dulness and râles can be made out. The sputum is sanguinolent rather than rusty and is crowded with plague bacilli. The cases are almost invariably fatal. One of Novy's students at Ann Arbor, working with a bacillus isolated by the Federal Commission in San Francisco, got plague-pneumonia through laboratory infection, and was studied by Novy and Dock. He was given large quantities of the Paris serum, and fortunately recovered.

The *plague-septicemias* are probably always fatal; a few cases with pyemic abscesses recover.

Among the complications may be mentioned suppuration of the buboes, carbuncles, edema of the glottis, femoral thromboses, meningitis, septicemia or pyemia, bronchitis and bronchopneumonia, nephritis, and marasmus.

Of the sequelæ, the most important hitherto met with are prolonged suppuration, arthritis (especially of the knees), otitis, persistent tachycardia, vasomotor paralysis, blindness, deafness, paralyses (local and general), ataxia, and various psychoses.

Mortality and Cause of Death.—From 80 to 90 per cent. of the cases among Asiatics treated by ordinary methods die. The mortality is usually highest at the acme of the epidemic, lowest at the beginning and the end. The rate of mortality is much lower among well-nourished Americans and Europeans living under good hygienic conditions. Individual epidemics vary remarkably in severity. Children and the aged almost always die; strong adults have the best chance of recovery. Plague-septicemia is almost invariably fatal; plague-pneumonia almost always kills; in the bubonic form an inguinal infection, *cæteris paribus*, permits of the most favorable prognosis; a cervical infection is more grave. Heart failure is a common cause of death, as is also the general intoxication in a plague-septicemia. According to Wilms, 70 per cent. of all cases die within the first six days.

Main Objects of Treatment.—Prevention is the main thing. Once the disease is developed, the physician is almost powerless in combating it. Avoidance of infection and prophylactic inoculation is then all important. Treatment is as yet largely supporting and palliative. Attempts at a specific therapy have not been brilliantly successful, though a serum has been prepared which appears to exercise a slightly favorable effect upon the course of the disease.

TREATMENT

General Prophylaxis.—Now that the specific microörganism which causes plague is known, the conditions of its life in animals other than man and in the external world are coming to be understood, the modes by which the bacillus is directly or indirectly transferred from the sources of infection to susceptible human beings have been made out, and the portals of entry into the interior of the organism have been recognized, the materials for the foundation of a rational prophylaxis against the disease are available. Plague is a preventable disease, and mankind has only itself to blame if the disease continues to prevail and spread. The sources of infection, the paths of transport of the infective material, the portals of entry, the amount and quality of the virus, and the susceptibility of the organism are the separate links in the chain of causation with which we have to deal. We may try to prevent plague by interfering with all or with any one or more of these elements.

The *sources of infection* in plague, aside from laboratory accident, are (1) human beings and (2) animals (rats, mice, monkeys, cats) suffering from the disease. As a rule, when plague is brought to a place hitherto free from it, the rats are infected first, and then bubonic plague begins among the human beings; the virulent epidemics of primary plague-pneumonia do not follow directly upon rat epidemics, but are secondary outgrowths of epidemics of human bubonic plague.

The first principle of plague prophylaxis consists in the *prevention of the entrance of plague-infected animals or human beings into regions free from the disease* (international and intranational prophylaxis). Plague, like cholera, is for Europe and America an exotic malady, which is brought from Asia almost solely by way of the sea.

Ideas regarding *quarantine* have undergone great change since the advent of the bacteriologic era. The old methods of forty-day quarantine and reckless hold-up of travel and trade have been abandoned. No matter how rigidly such methods were enforced, absolute safety could never be guaranteed. The modern principle is to insure a *maximum of safety with a minimum of interference* with commerce and travel.

The greatest reforms in plague quarantine have been brought about through the activity of *international sanitary conferences*. Especially noteworthy in this particular have been the two congresses held at Venice, one in 1892 and the other in 1897. The Dresden conference in 1893, and that held at Paris in 1894, have also been important factors. The protocols of these conferences make interesting reading for everyone concerned with plague quarantine. As a result of these conferences, a system of obligatory international notification of plague-infected seaports has developed, and, if plague develops in a country, international quarantine does not apply to the whole country, but only to the particular region infected. Moreover, rigid measures apply only during the actual existence of the disease, and are regarded as unnecessary when no cases of plague have been reported in the region for ten days. Definite rules have been made with regard to seagoing vessels. Each vessel is strictly inspected by a medical officer before its departure. Suspected persons are prevented from going on board. The clothing and effects of third-class passengers are disinfected. A pure water supply is provided. Orders are given that ships shall be kept clean during the voyage, and provision is made for the isolation and disinfection of a suspected case should it develop. On the arrival in harbor of a ship from an infected port, an investigation is made by the local quarantine officers, and if the voyage has lasted longer than the maximum incubation period of plague and no case has developed, the vessel is free. If suspicious cases have existed on board, a careful medical examination of the passengers and crew is undertaken, suspected rooms are disinfected, and all the water on the ship is removed and the containers disinfected and a pure water supplied. The first-class passengers are permitted to go on their way, but the crew and steerage passengers are kept under surveillance for a period of ten days. If cases of plague exist on a ship when it enters the harbor, these cases are at once removed to an isolation hospital. The passengers and crew are carefully inspected, the ship is disinfected, and all on board are kept under surveillance for a period of ten days. So important is the Suez Canal as a gateway for plague from the East that a special supervision of incoming ships is maintained there. America is further protected from plague, as well as other epidemic diseases, at all times by the regulations regarding immigration. Emigrants about to sail from Hamburg or Bremen are compelled to arrive several days before the vessel sails, and they are kept under surveillance, are given a thorough bath, and have their belongings disinfected. This careful watch over seagoing vessels, together with the international agreement regarding the supervision of pilgrimages to Mecca, has done much to limit the spread of plague.

General international quarantine measures are much less important than the measures which can be undertaken within each individual country. No system of international quarantine will probably ever be devised which can yield absolute safety, for, with the greatest care, latent or more often convalescent cases of plague will slip through. We now know that *a convalescent plague patient may give off virulent plague bacteria in his excreta for seventy-six days after his symptoms have disappeared.* Even the most rigid quarantine would be obviously powerless in such circumstances.

The tendency at present is to make international quarantine ever more lax, and to depend more and more upon a revision system and upon intranational prophylaxis. The international code of quarantine is still too strict in certain particulars. There is much unnecessary red-tape which should be given up; if skilled ship-physicians and harbor-physicians are in control, great individual liberty should be permitted. In spite of the reforms which have been made, there is still unnecessary delay to travel and unjustifiable interference with trade. In one respect, perhaps, the international rules might with advantage be made more strict. *Greater care should be exercised with regard to rats.* Sea quarantine has as yet failed to deal adequately with the rat question. Undoubtedly plague is more often transferred from port to port by rats than by men. In infected seaports no ship should tie up at the wharf, but should be loaded, if possible, from lighters, or if ships must tie up to wharves, every precaution should be taken to prevent the access of rats to the ship. Cables should be protected by metal funnels which prevent rats from climbing up. Communication between the ship and the dock should be cut off, at night especially. Even if infected rats do not pass from the dock to the ship, rats already on the ship may become infected through contaminated articles brought on board. It is very desirable, therefore, to kill all the rats on board the ship, and methods for doing this have been devised, chiefly with the aid of irrespirable gases, such as carbon dioxid or sulphur dioxid. A ship arriving in America from an infected port should be carefully supervised in its unloading, and if dead rats are found they should be examined at once bacteriologically, and if plague stricken, suitable disinfective measures should be undertaken. As far as grain and goods are concerned, surface disinfection suffices.

Perhaps the most important point in *intranational prophylaxis* against plague is *provision for the immediate recognition of the first case by bacteriologic diagnosis.* If the first case be recognized, and proper measures be at once undertaken, an epidemic may be nipped in the bud. In places where there is a likelihood of plague infection there should be obligatory inspection of all dead bodies, and a close watch should be kept upon all cases of obscure illness. *Mere clinical observation should not be trusted in any suspicious case, but a rigid bacteriologic examination should be made.* In plague times a plague-pneumonia may be wrongly regarded as a simple pneumonia or as an influenza and the disease spread like wildfire. Plague pneumonia is rarely seen at the beginning

of an epidemic, however—the first cases are always bubonic. If a plague-pneumonia is met with, one may be almost positive that bubonic cases in human beings have preceded it, and evidence for this should be immediately sought for. Should the first patient, as is nearly always the case, be bubonic, a bacteriologic examination of the rats of the house and neighborhood should be at once undertaken. *Every suspicious case should be isolated and treated as though it were plague, pending the result of the bacteriologic examination.* A simple case of bubonic plague is not likely to spread the disease; if in such a case, however, a *secondary* plague-pneumonia should develop, the comparatively innocuous patient is at once converted into the direst menace to those who come near him. This is too often forgotten; it is why every case of plague, no matter how simple it may seem, should be strictly isolated. In San Francisco, when occasional cases of plague were recurring among the Chinese, there were not a few doctors, especially among those who were trained in the prebacteriologic era, who declared that the cases were not plague, but simple "glandular fever." "How can it be plague?" they asked. "We have been seeing such cases for a long time and there has been no great outbreak."

The *isolation should be obligatory*, either in the patient's dwelling, in which event the house must be watched by sanitary police, or, better, where possible, in an isolation hospital or improvised plague-barracks. In dwelling or hospital, the patient is to be isolated from other inmates, his bed surrounded by a fine netting, to prevent spray contamination of physician and nurse in case the sputum contains the bacilli. All secretions and excretions (sputum, urine, feces), as well as soiled linen, are to be thoroughly disinfected; contamination of the floor by any infective material is to be especially avoided. Attendants should, on leaving the room, disinfect the boots thoroughly on a mat saturated with sublimate solution. The physician, on entering the room, should leave his coat outside, roll up his sleeves, and don a linen coat. On coming out, he should remove the latter, and disinfect his arms and hands in sublimate solution before putting on his coat again. The nurse should take suitable precautions against infection. She should see to it that all objects with which the patient comes in contact are disinfected. The buboes and any skin-lesions should be kept covered with moist sublimate poultices.

In case the patient dies, the body should be wrapped in a sublimate sheet and coffined. It should be buried ten feet deep. No funeral at the house should be permitted, but there is no objection to friends accompanying the body to the cemetery.

Should the patient recover, the isolation should be continued until bacteriologic examination on two occasions proves that there are no longer plague bacilli in sputum, feces, or urine. In simple bubonic cases all danger is usually over in a week after the disappearance of the symptoms, but *in cases of plague-pneumonia or sepsis which survive, the convalescent may be giving off bacilli for ten or eleven weeks after convalescence begins.*

All who have been near the patient shortly before his attack should be kept under medical surveillance for at least a week, either in other rooms in the house, or, in times of epidemic, in special "segregation camps."

House disinfection should be thorough. Beds and mattresses should be disinfected by steam if possible and the rooms by formalin. Floors and wainscotings should be scrubbed with sublimate solution. Soiled linen should be soaked in lysol or steam-sterilized.

If cases of bubonic plague begin to appear apparently spontaneously among a population, it may almost be taken for granted that a wide "infection of the community" has been brought about by rats. The simple disinfection of houses in which single cases occur will not suffice to stamp out the disease, but the so-called "*generalized disinfection*" must be resorted to in order to destroy all infected rats and sterilize all contaminated objects in the infected part of the town. A systematic organization of a large disinfecting force, divided into posses of ten, each squad under a special superintendent, is necessary. There is to be a general "clean-up," especially of floors, yards, cellars, garbage-boxes, manure-piles, rubbish-heaps, etc. All dead rats, garbage, and rubbish should be removed to a crematory or burning-place on the outskirts of the town and destroyed. Floors, stairs, and wainscotings are disinfected with 1:1000 sublimate solution. Walls, ceilings, and furniture are disregarded in "generalized disinfection." Sublimate solution is poured into rat-holes and the holes filled with cement. The work is carried on simultaneously at as many different points as possible, and in a relatively short time an enormous amount of work can be accomplished. In this way the disease has been finally stamped out in Chinatown, San Francisco, through the coöperation of the local health authorities with the Marine Hospital Service. Brilliant results have similarly been arrived at in Egypt, under the direction of Sir Horace Pinching.

In addition to generalized disinfection, a *campaign directed especially against the rats* should be undertaken. We know no sure method, however, of successfully conducting such a campaign. It is relatively easy to rid a single isolated building of rats by systematic trapping, rigid cleanliness, cementing floors and occluding holes, but to rid an entire town of rats is another matter, especially where garbage ordinances are lax and sewerage systems are old and cannot be properly flushed. Attempts at poisoning with phosphorus or arsenic, at extirpation by offering premiums, at catching with ferrets (the ferrets contract plague), at destroying with artificial epidemics (Danysz bacillus)—all are unsatisfactory. Steady energetic measures, carried out through a series of years, especially in the direction of general cleanliness and improved sewerage systems, yield the best results.

Individual prophylaxis is so important in the prevention of plague that even in great epidemics individuals who live hygienically are rarely attacked. In San Francisco the disease spread but little, and the malady was almost wholly confined to the filthier of the Chinese. In

India and in China, where many thousands have died, the lowest classes have been the ones attacked; the better classes of the natives and Europeans escape almost entirely. In Bombay, Dr. Weir told Dr. Flint and the writer that the prostitutes (who live in relatively large and well-ventilated houses) were, in spite of their irregular lives, seldom stricken.

Circulars of information should be distributed among the people when plague prevails for the purpose of education in individual prophylaxis. In addition to keeping up the general strength by good food, certain special points that should be emphasized are the avoidance of fatigue and excess of all kinds and the maintenance of the strictest cleanliness of body and dwelling. Unusual attention should be paid to keeping floors clean and sterile; no one should go barefoot, and walking with bare feet, even in one's own house, should be warned against. The slightest abrasion of the skin is dangerous in plague times and should be carefully avoided; any cutaneous injury, however slight, should be dressed antiseptically. A full bath should be taken once daily; where this is not practicable, at least the extremities, genitalia, and perineal region should be washed frequently. Mats soaked in sublimate or lysol solution should be kept at the entrance of houses, and the boots thoroughly cleansed on these on returning to the house from work. Everyone should be warned against touching a dead rat with the bare hands; if dead rats are found, the police or health authorities should be notified, or, if necessary to remove them at once, they may be handled with tongs or picked up in a cloth soaked in sublimate solution. Food should be kept where it cannot possibly be contaminated by rats.

As regards *prophylactic inoculation*, a great many methods have been tried. Attempts at *active immunization* have been made by injection of (1) living, feebly virulent cultures; (2) artificially attenuated cultures; (3) dead cultures (Haffkine's method; method of German Commission; Lustig-Galeotti method; Terni-Bandi method). Passive immunization has been tried by means of various plague sera (Paris serum of Yersin-Roux; Lustig's serum; Bernese serum of Travel; "antitoxic" serum of Markl; San Paulo serum of Vital Brazil).

The Haffkine inoculations, especially if repeated two or three times, give at least a relative immunity lasting several months. It is not at all comparable, however, in protective value to that yielded by vaccination against small-pox, and scientific opinion is at present adverse to universal obligatory inoculation even for countries like India and China. Its use should rather be limited to small groups of the population, to ships, barracks, and inmates of plague houses, and to the immunization of individuals who are frequently or continuously exposed to infection—*e. g.*, physicians, nurses, orderlies, laboratory servants, cleansing and disinfecting corps, and the like. Adult males receive 3 to $3\frac{1}{2}$ cc., adult females 2 to $2\frac{1}{2}$ cc., children over ten 1 cc., small children 0.1 to 0.5 cc. of the prophylactic, injected subcutaneously. The reaction varies greatly in different individuals; as a rule, there is slight fever, malaise

with local swelling, and edema for twenty-four or forty-eight hours. Ten days later a second, larger dose may be given, the size varying according to the reaction following the first dose. The statistics of results from various prophylactic inoculations are given by Dievonné in Kolle and Wassermann's Handbook, which should be consulted by those interested, as space will not permit of their introduction here. Haffkine's inoculation does not make one absolutely safe; from 4 to 20 per cent. of the inoculated contract the disease and from 2 to 8 per cent. die.

Passive immunization as a prophylactic inoculation may be resorted to when an immediate immunity is desirable, as when a physician has cut himself or gotten a needle-prick at a plague autopsy, or a laboratory worker has had an accident with a plague-culture or an experimental animal. It may also be employed for individuals who are temporarily exposed to great danger of infection, for example, nurses caring for plague-pneumonia. In such cases large doses of the Paris serum should be given. Any immunity thus gained lasts but a short time (only a few days), and if the individual is to be further exposed he should arm himself by Haffkine inoculation or by some one of the several methods of active immunization.

Some experiments have been made which indicate that a *combined immunization* (*active and passive*) yields better results than either alone (Shiga, Besredka, Kolle and Otto).

Prophylactic inoculation is to be regarded only as an aid to the other important methods of prevention. It is to be feared that in some places too much stress has been laid upon inoculation and too little upon cleaning up, disinfection, rat-killing, and isolation.

Let us turn now to the *treatment of the actual plague-infection* in human beings. There has been much dispute as to whether Haffkine inoculation after actual infection has occurred can or cannot be helpful to the patient. It seems probable that it can only do harm, for once the infection is started the symptoms are due to poisoning (metabolic products of bacterial growth, poisons set free from bacterial bodies by bacteriolysis), and the introduction of Haffkine's fluid can only add to that poisoning, for the Haffkine fluid consists of old bouillon cultures in which the bacilli have been killed by heating for one hour at 65° C.; it contains soluble poisons as well as dead bacteria. How is it with the use of the various sera which have been prepared, and especially with the Paris serum? In as far as these are antitoxic sera they may be helpful, but plague is less a disease in which "toxins" play a part than one in which the so-called "endotoxins" are active; in other words, it is more like cholera and typhoid than it is like diphtheria or tetanus. Examination of the sera shows that they are, as a matter of fact, chiefly anti-infectious or bacteriolytic and only moderately antitoxic. The antitoxic effect can be only good; it is conceivable that the anti-infectious or bacteriolytic effect may do actual harm, unless the serum could be used immediately after the plague bacillus has gained entrance to the body and before it has multiplied to any great extent. Should the serum be

given when only a few bacilli are in the body, it might, by bacteriolysis and the stimulation of phagocytosis, lead to complete destruction of the bacilli at once, and so to cure. But should the serum be used only after the bacilli have multiplied extensively, then when it exerts its bacteriolytic effect it can only increase the poisoning by endotoxins, and the actual symptoms of plague are apparently chiefly the result of the death of plague bacilli and the setting free of their intracellular poisons. Spontaneous cure of plague does not destroy all the plague bacilli in the body; on the contrary, great numbers of plague bacilli live for weeks and months often in the bodies of convalescents. Bacteriolysis is helpful apparently chiefly at the beginning of an infection by nipping it in the bud. If it be insufficiently powerful to stop the infection in its initial period, bacteriolysis becomes later positively harmful, for it sets free the poisons which do the injury. Rather than to attempt to increase bacteriolysis then when the symptoms are well developed *it would seem to be more rational either to leave bacteriolysis alone, or, if possible, to inhibit bacteriolysis*, either by destroying complement or by introducing anti-amboceptors. The complements may be destroyed or inhibited in their action by certain salt solutions (see the general work of Hektoen and his pupils), and anti-amboceptors may be prepared by making anti-immune sera. It would seem to me worth while to experiment, therefore, along the lines of complement-inhibition or anti-amboceptor introduction in the treatment of plague. Clinical experience is the ultimate test for all remedies, and, beside, observation teaches that the Paris serum apparently exercises a slightly favorable effect upon the course of plague infection, but this is insufficient to permit the postulation of any definite therapeutic value. The same may be said of Lustig's serum and of other sera. It seems to me probable that the good therapeutic effects of the antitoxic constituents of plague sera are almost fully counterbalanced by the evil effects of their bacteriolytic influence. If the antitoxic power could be used without the exertion of the bacteriolytic effect, much better results might be hoped for. [I am writing now of therapy, not of prophylaxis.]

No drugs are known that can be given to plague patients that will inhibit the growth of the bacilli or neutralize their poisons. Local treatment of the buboes, aside from sublimate poultices, and, in case of suppuration, incision, is of no value. Injections of carbolic acid, tincture of iodin, and sublimate have been tried and abandoned. Early excision of glands in bubonic plague might be further tried; cure has followed in certain instances, but in others plague-septicemia or metastatic plague-inflammations (meningitis) have followed. In plague-pneumonia inhalations of a spray of carbolate of lime solution (1 per cent.) have been recommended. It is said that syphilitics who have been saturated with mercury stand plague better than ordinary individuals; in Bombay, accordingly, large doses of sublimate have been tried, and it is said that plague patients show a high tolerance to the drug and do well on it. It is doubtful if it is of any value. To promote the elimination of toxins from the body, a dose of calomel may be given at the beginning of the

disease, followed in five or six hours by a saline (Cantlie). The skin should be kept active and the patient should be encouraged to drink water and milk. The main hope after the disease is well-established lies in careful symptomatic treatment (*vide infra*).

Symptomatic Treatment.—The gravest symptoms in plague are manifested by the heart and circulatory system. The plague poisons are extreme depressants. From the beginning the strength of the heart is to be supported. Stimulants are required early. Camphor, musk, caffein, ether, or alcohol may be used. If there is extreme vasomotor paralysis adrenalin may be cautiously tried. Especially in plague-pneumonia must the heart be watched.

The fever if high may be met by ice-bags to the head and by cold baths and packs. Antifebrile drugs should be avoided. Antifebrin and the coal-tar products especially should never be given, owing to the heart weakness which characterizes the disease.

Sweating should be favored, should it appear, by the administration of warm drinks.

For restlessness and insomnia small doses of hyoscin (0.0006) may be given by hypodermic injection. Vomiting should be controlled by cracked ice, a mustard plaster over the stomach, or hypodermics of morphin.

Should a hemorrhagic diathesis develop and subcutaneous hemorrhages appear, ergotin or gelatin may be given.

The treatment of cardiac weakness and pneumonia has been referred to above. Suppuration of buboes should be treated surgically. If arthritis develops, the affected joints should be immobilized and wrapped in cotton; if they suppurate, the surgeon should be called in. Carbuncles and furuncles may require surgical interference; when discharging, they should be kept covered with moist sublimate dressings to prevent contamination of surroundings.

Should edema of the glottis occur in cervical bubonic plague, prompt tracheotomy may be indicated.

For femoral thrombosis, the leg should be slightly elevated and kept warmly wrapped.

If symptoms of meningitis appear and plague bacilli are demonstrable in the fluid obtained by lumbar puncture, 30 to 50 cc. may be withdrawn, and 10 to 20 cc. of normal serum may be introduced into the cavum subarachnoideale (Hektoen's method).

In plague nephritis during convalescence the diet should be non-irritating, consisting chiefly of milk.

The other complications and sequelæ are to be treated according to general principles. A persistent tachycardia is sometimes relieved by ice-bags over the precordium. Digitalis may be necessary if the heart be actually dilated.

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YELLOW FEVER[1]

By James Carroll, M. D.

The rational treatment of any disease must be based upon a knowledge of the nature of the causative agent or the lesions produced by it within the body. Of the real nature of the causative agent of yellow fever we know absolutely nothing, except that in the form in which it exists in the blood of the patient it is so extremely minute that it has hitherto escaped detection under the best powers of the microscope, and that from the biologic points of view it possesses several points of resemblance to the parasites of malarial fever. For instance, it appears to be an obligate parasite, having two separate and distinct cycles of development, one within an invertebrate host, the mosquito; the other, within a vertebrate, man. Again, when transferred from man to man directly, by means of an injection of blood, it can continue to multiply in the same cycle and bring about the disease in a second individual. Whether or not this cycle of development could be maintained indefinitely by continuously repeated transfers from man to man has not been shown; in all probability, it could not. One would expect that after a certain number of transfers the power of the parasite to reproduce itself in that cycle would be exhausted, and it seems possible that, after a given number of such transfers, it would become attenuated or degenerated to such a degree that an injection of the blood containing it might be relied upon to convey with certainty a mild attack of the disease and confer subsequent immunity. In view, however, of the simplicity of the means now known to be effectual in controlling and suppressing yellow fever, it would scarcely be justifiable to risk human life in an attempt to solve any such biologic problems, and their elucidation must be deferred until the discovery of another vertebrate host, of the existence of which there is at present no indication. The various points of resemblance between the modes of dissemination of yellow fever and of malaria depend upon the nature and habits of an invertebrate host. From this standpoint, and judging from analogy, the parasite of yellow fever, whatever its nature, seems to belong more probably to the animal than to the

[1] This article, as well as that on Dengue, were prepared by Dr. Carroll shortly before his much-lamented death. The editors, with a view to ensure the article being not only authoritative but also the latest pronouncement on the subject, recently sent it for revision to Dr. Juan Guiteras, now of Havana, Cuba. Dr. Guiteras wrote that Dr. Carroll was an authority and his opinions entitled to great respect; that the article is very personal, and for this reason should not be altered; and that nothing new has been added to the treatment since the article was written. And he added: "The disease is dying out; in a few years it will be a paleontologic study."—Editors.

vegetable kingdom. There is no evidence that it occurs free in nature or in any living bodies other than those of man and the mosquito.

Of the pathologic changes occurring in yellow fever we know much more, because they are demonstrable to the naked eye as well as by means of the microscope. These, with the clinical symptoms, must be our chief guides in determining the mode of treatment.

In localities where yellow fever does not prevail, and in the absence of a knowledge of the previous history of the patient, there is no single diagnostic sign that can be relied upon absolutely in determining the nature of the disease in the first day or two of the attack. The severe headache, suffusion of the skin and eyeballs, icterus, hemorrhages from the mucous membranes, and even the black vomit, may occur in other pathologic conditions. The previous history of the patient is of great importance, because his place of occupation, abode, or a change of habitat by sea or by land, may show that he has been exposed to the chances of infection through the bite of a mosquito, the only means of infection that can now be recognized. The season should also be considered in determining the probability of the case being one of yellow fever.

The premonitory symptoms are malaise, dull headache, occasional aching pains in the lumbar region and loins, rachialgia, constipation, furred tongue, impaired appetite, and usually vertigo. They may be so slight as to escape notice, or the patient may retire in his usual health, to awake during the night with a chill. The onset is generally with a chill accompanied by severe headache, usually frontal in location, with racking pains in the back and limbs, followed soon by fever with marked suffusion of the face and eyeballs, nausea, and vomiting. Photophobia is usually present at this stage, and an exceedingly valuable, and almost invariably constant symptom, is the presence of marked tenderness upon the most gentle deep pressure in the epigastrium, either on the first or second day. The temperature may reach 104° to 106° F. in severe cases, while in milder ones it may not rise above 101° or 102° F. The pulse-rate may be only 90 or 95, or it may be 120 to 130 in the severer cases; in quality it is full and strong. After the first twenty-four hours there occurs a progressive slowing of the pulse-rate independent of the temperature curve; consequently in the secondary elevation of temperature the pulse-rate is becoming progressively slower while the temperature is rising. This phenomenon of lack of correlation between pulse-rate and temperature is known as Faget's law, and it is of great diagnostic value; but, while it is constant in the pronounced cases, it is not sufficiently well marked in many of the milder ones to be alone relied upon. The initial rise of temperature is followed, after twenty-four, forty-eight, or seventy-two hours, by a remission or, rarely, complete intermission, frequently of such short duration that it may escape notice in the mild cases unless the temperature is recorded at intervals of three or four hours. The height and duration of the initial fever may be regarded as an index of the severity of the attack; when the remission occurs on the third day, after the temperature has stood at 103° F. or higher,

the case is a severe one; when the remission or a complete intermission appears in about twenty-four hours, and the initial temperature has not risen above 102° F., the case may be regarded as mild, and the prognosis is good, provided appropriate treatment is instituted early, and the patient's heart, liver, and kidneys were previously in sound condition.

In the milder cases the skin remains moist and the secretion of urine is maintained; in the severe ones, the skin remains dry and hot, and the secretion of urine is diminished or suppressed. Retention of urine is common during the first few days. The tongue is at first slightly furred, its tip and edges are red; later it becomes coated, and, in severe cases, fissured and darkly stained with blood. The gums may at first be injected or pale, swollen or spongy; after the second or third day a red line appears at the margin, and blood will be seen to ooze out upon moderate pressure, or the oozing may be constant without pressure. On the second or third day the bright injection of the scleral conjunctivæ and skin is less marked, and through the former there is seen a yellowish tingeing of the sclerotics, while the skin of the face and chest, of the latter especially, takes on a dusky hue, and upon pressure it can be observed that the capillary circulation is sluggish. After the third day, the icterus becomes more pronounced, the eyeballs are quite yellow, the skin of the whole body is distinctly yellow, and for a day or two the color continues to become deeper. After the fifth or sixth day or much earlier, if the case be a severe one, minute dark specks, resembling fragments of fly wings, appear in the material vomited. These may become more numerous, coarsely granular and dark brown or brownish-black in color, and resemble coffee-grounds; hence the name coffee-ground material. When this material becomes more abundant from free hemorrhages we have the typic black vomit. After the third or fourth day blood may be present in the stool; it may be so abundant later as to impart a dark tarry appearance to the fecal matter or the discharges may consist of almost pure blood.

A guarded prognosis must always be given, because yellow fever is full of surprises for the physician, and a mild case may at any time become severe; a severe relapse may occur in a mild case apparently entering upon the period of convalescence.

In the treatment of this disease a knowledge of the pathology enables the physician to direct his efforts toward a definite end, in order to secure results that offer the best chances for the recovery of the patient. If the treatment is purely symptomatic, it lacks the direction necessary to reach promptly the prime cause of the symptoms, and time is lost. This time is invaluable in the treatment of patients suffering from sharp attacks of yellow fever, and the failure of the physician to act promptly may cost the patient his life.

Systematic examinations of the urine are of great value as aids in diagnosis and prognosis. A trace of albumin is usually found to be present on the second or third day if all specimens are examined. It may be present in one specimen and not in another. The sediment from the urine on the first day usually shows a large number of mucous

or hyaline threads. In cases of average severity hyaline casts appear generally on the third or fourth day; granular and epithelial casts, more or less intensely stained with bile, are found a day or two later; red blood cells may or may not be conspicuous, and, following the use of even a clean catheter, a few polymorphonuclear leukocytes will always be seen. In mild cases it may require careful observation to secure a specimen in which only a trace of albumin is present; on the other hand, the amount may be so large as to coagulate the urine when heated. No matter what the condition as to albumin may be, there is always hope so long as the heart action remains good and the quantity of urine passed is fairly large. If the hemoglobin percentage be less than 80 or if Ehrlich's diazo-reaction be obtained, the case is in all probability not one of yellow fever (Guiteras). A marked leukopenia is also against the diagnosis of yellow fever (Van der Velde).

TREATMENT

In yellow fever we are dealing with a severe, acute, infectious disease, of short duration, in which there is elaborated within the body a powerful toxin that manifests a marked affinity for the epithelial cells of the liver. The endothelial cells of the capillaries throughout the body are also affected, to the extent that they show evidences of fatty degeneration, and similar changes may be found in the epithelium of the kidney and digestive tract and in the muscle-fibers of the heart. It is probable that the cardiac depression so constantly present is due, to some extent, to the action of the poison upon the cells of the central nervous system. The black vomit, usually but not always a fatal symptom, results from two chief causes—viz., a weakened heart and damaged capillaries, the latter condition being due partly to the former and partly to the direct action of the toxin, which is, beyond question, the primary active factor in producing the pathologic lesions and grave symptoms. We have no antidote in the form of an antitoxic serum for the poison of yellow fever; consequently, as with other poisons, there is a direct indication for its prompt removal. This can only be effected by elimination, without delay, through the natural channels, the kidneys. It is of vital importance, therefore, to maintain the functional activity of these organs from the beginning by the use of mild alkaline or other diuretics. The removal of a large part of the toxin by this means lessens the effects of the toxin upon the nerve and liver cells, and prevents that excessive destruction of the parenchyma of the liver which deprives it of the power to elaborate the amount of urea necessary to maintain the functional activity of the kidneys. In the normal human body certain end-products of tissue metabolism, chiefly the carbonate, carbamate, and lactate of ammonia, which in themselves are poisons, are brought to the liver, and there converted into urea, which, in its turn, is carried to the kidneys, where it serves as their normal excitant in secreting urine. In the event that the waste ammonia compounds mentioned are no longer converted into urea, they are retained in the circulation and act as addi-

tional poisons, while, at the same time, the kidneys cease to functionate because their normal stimulant, urea, is no longer supplied to them. In cases of anuria from this cause it is justifiable to administer urea hypodermically, in doses of about 1 gm. or less, to maintain the secretion of urine. This has been tried in other conditions with success, and urea, in small doses, is no longer regarded as a poison. It is now being conceded that the so-called uremic convulsions and coma are, in many instances, not uremic at all, but are due to conditions of ammonemia resulting from disturbances, not of the kidneys, but of the liver.[1]

That the ultimate condition in fatal attacks of yellow fever is really an ammonemia, rather than an acidemia, seems probable from the reported results of Dr. Joseph Jones,[2] of New Orleans, formerly professor of chemistry and of clinical medicine at Tulane University. Dr. Jones studied the pathology of the disease with painstaking care, and his results can be accepted. In describing the conditions found *post mortem*, he states in his last paragraph that the bladder contains little or no urine, and that the urine is loaded with granular fibroid matter, *urate of ammonia*, casts, and renal cells. Dr. Purdy, in his work on Urinalysis, states that in yellow fever the reaction of the urine is usually acid throughout the first stage and becomes alkaline during convalescence; the urea is greatly diminished, sometimes totally absent. Aitkin[3] stated that ammonia was universally present in black vomit, and frequently in the breath, feces, and tissues.

Further work in this line is much to be desired, and a thorough and systematic study of the chemistry of the urine in a series of cases, throughout the disease, would probably throw a flood of light upon the exact nature of the morbid processes.

The action of the toxin upon the liver cells in yellow fever produces also another effect, a mechanical one, viz., excessive swelling of these cells, with resulting pressure upon the capillaries and interference with the portal circulation, causing a mechanical hyperemia in the intestine and mesentery from which it receives its blood-supply. For anatomic reasons, the effect of the hyperemia is most marked in the vicinity of the upper jejunum and duodenum. The combined action of this blood stagnation and of the toxin is to render the capillaries permeable to red blood-cells through diapedesis and rhexis; hence the deduction is logical that, if the kidneys can be induced to act freely early in the disease, the maximum amount of toxin will be eliminated, the excessive degenerative swelling of the liver cells will be prevented, and the organ will be able to supply sufficient urea to maintain the renal function. Further, the circulation through the liver will be less obstructed, because the epithelium will be less affected by the toxin which is now freely eliminated; the passive hyperemia of the intestinal mucosa will be less marked, and there will be a lessened tendency to the occurrence of passive hemor-

[1] See article on the Treatment of Yellow Fever in the Journal of the American Medical Association, July 19, 1902.

[2] Transactions of the Pan-American Medical Congress, Washington, 1893, vol. ii.

[3] Science and Practice of Medicine, London, 1880, vol. i, p. 651.

rhages and black vomit; at the same time there will be a smaller amount of toxin present in the blood to depress the heart, and thus deprive the capillary endothelium of its normal supply of nutriment which is derived directly from the circulation. These points are dwelt upon at length in order to make clear the rationale of the treatment that will be suggested.

It is the duty of the local officials, and of the physician in charge of a case of yellow fever, to see that the patient is not treated in the locality where his infection took place. Unless the case is grave from the beginning, the patient should be removed at the earliest moment to a hospital situated upon high ground, without the limits of the city, and thoroughly protected by fine wire-gauze and mosquito nettings, in an environment free from mosquitoes. It is clearly the first duty of all concerned to guard against the possibility of his becoming a source of danger to others, and the only way to insure the safety of the community is to make it an absolute rule that all suspicious cases (not diagnosed, and occurring in localities where yellow fever is known to exist or to be imported) be removed, isolated, and protected from mosquitoes as soon as they come under observation. The patient can be lifted in his cot or bed and transported in a rubber-tired ambulance, in the middle of the day, without danger to himself or others.

For reasons already stated, success in treatment can only be expected with confidence when proper measures are instituted at the outset. These are so simple that harm cannot result, no matter what the nature of the disease may be. The golden rule of securing a prompt evacuation of the bowel should always be followed, and for this purpose nothing is better than sodium sulphate, the great value of which was first demonstrated by Dr. Kearsley, of Philadelphia, in 1741. Dr. Touatre, of New Orleans, used sulphate of soda or magnesia as a matter of routine throughout the course of the disease, giving an enema of a pint of warm water containing a tablespoonful of the salt every morning and night. The treatment may be begun with 4 gm. in a wineglassful of iced water every hour, continued until an evacuation is secured. The saline may be preceded by 0.20 gm. of calomel with bicarbonate of soda, or, if the stomach be irritable, several minute doses of calomel may be given at short intervals and followed by the saline in small and repeated doses; if these be rejected, a simple enema of soapsuds should be administered to secure the desired result. Then give night and morning the enema of a tablespoonful of the sulphate, as recommended by Touatre. As soon as the bowel has responded satisfactorily a hot mustard foot-bath should be applied, and the patient be made to perspire freely by covering him with blankets and administering hot drinks (lemonade), if necessary, or 2 cc. of sweet spirit of niter, at half-hour intervals until the skin becomes moist. For irritability of the stomach a sinapism is the best application, and for cephalalgia ice-cold cloths afford relief until the pain subsides. Coal-tar preparations should be avoided, and morphin is not necessary—according to Touatre it is a poison in yellow fever. After the foot-bath, evacuation of the bowel, and diaphoresis, the patient should be permitted to sleep. The room should be darkened at all times,

the windows be kept open, and doors, windows, and other openings securely screened; the patient should be kept always beneath a mosquito bar. Absolute rest is essential; the patient should never be permitted to sit up or to rise from the bed until he is nearly convalescent; he should be moved in the recumbent attitude whenever it is necessary to change his position in order to make him comfortable. He should be protected from draughts.

It is of vital importance to note carefully the secretion of urine, and each specimen voided should be measured, recorded, and then preserved to be tested for albumin at least. Retention of urine is rather frequent in the early stage, in which case it is necessary to use the catheter; later, the secretion may be suppressed. Every stool should be preserved until it has been inspected for evidence of the presence of blood. The temperature and pulse-rate should be taken and recorded every three hours. So long as the temperature remains above 103° F., complete sponge-baths should be given with cold water every hour or half-hour, according to the height of the temperature; these should be continued day and night. If the temperature remains between 102° and 103° F., the baths should be given at intervals of two hours. The patient must be encouraged to drink freely of mineral water, and the best is iced carbonated Celestin's Vichy, as recommended by Touatre. Every effort should be made to obtain this if possible; if it is necessary to substitute other mineral waters, they should be alkalinized by adding a small teaspoonful of bicarbonate of soda to the quart. Carbonated Vichy water is grateful to the patient; it quiets the stomach and furnishes carbonate of soda, which seems to exert a very beneficial constitutional effect in this disease. The remarkable results obtained with the Sternberg mode of treatment afford additional evidence in favor of the alkaline treatment.[1] Sternberg's method consisted of the administration of minute doses of bichlorid of mercury, with 10 gr. or more of bicarbonate of soda in solution, every hour, day and night. When the bichlorid and soda were tried separately in the same epidemic the mortality rate was 28 and 6.3 per cent. respectively. According to Allbutt, in 743 cases treated in the United States, Cuba, and Brazil, the mortality was only 7.3 per cent. These facts are worthy of the most careful attention, for, when they are considered in conjunction with the excellent results in the treatment of yellow fever with Vichy water reported by Touatre,[2] and the recorded value of the same drug in renal affections, they show conclusively that for the successful treatment of this disease alkalies are indispensable and the sodium salt is the best. Further, it has been reported that the alkalinity of the blood is diminished in yellow fever; it is also well to bear in mind that sodium is the normal alkaline base of the blood plasma, and that the bicarbonate is a bland diuretic. These are facts that cannot be overlooked, and they afford the key to a successful line of treatment.

[1] Sternberg, Report on the Etiology and Prevention of Yellow Fever, Washington, Government Printing Office, 1890.

[2] Touatre, Clinical Notes on Yellow Fever, New Orleans, 1898.

A freshly prepared neutral mixture, made by adding 30 gr. of potassium bicarbonate to a dessertspoonful of freshly expressed and strained lime-juice, was given every two hours by Anderson[1] and, after thirty-four years' experience with the disease, he reported that after he adopted this mode of treatment he no longer encountered the hyperpyrexia and profuse black vomit that he had formerly seen. When the secretion of the urine lessened, he used in addition acetate or citrate of potash and spirit of nitrous ether, with a preference for the latter, given in dram doses every hour. The success obtained with the methods cited justifies the assumption that it is not only advisable but necessary to act upon the kidneys early in this disease, and secure elimination of the toxin, which, when retained, has a marked tendency to weaken the circulation by depressing the heart, and, in addition, causes serious disturbances of vital metabolic processes.

Depression is such a striking phenomenon in yellow fever that stimulants are directly indicated, and, in my opinion nothing is better than champagne. Stimulants are generally withheld until the third or fourth day; it is better to be guided by the feeling and desire of the patient: if he needs a stimulant, he will accept it and be grateful for it. Care should be taken that the dose is not large; 2 or 3 drams of good dry champagne, repeated at intervals of several hours, more or less, according to the effect, will be sufficient. The effect upon the patient is usually very grateful; the circulation is improved, the stomach is quieted, and he experiences a feeling of great comfort. One of our experimental cases, a Spaniard, treated in this way lay in bed in a happy frame of mind, quietly singing to himself, during the first three or four days of the fever, and after his recovery he secured many volunteers from among his countrymen by telling them that yellow fever was not the serious disease they had been led to believe. It is of the utmost importance to institute the simple treatment above outlined during the first two days of the fever, for the toxin has already been present during the several days of incubation, and if it be allowed to exert its cumulative influence for two or three days longer irreparable harm may follow. In the choice of a stimulant, champagne comes first; its value in allaying vomiting is already established, and the feeling of exhilaration imparted by it is most desirable. The stronger alcoholic liquors should be given only when the patient has been accustomed to their use and manifests a desire for them. The cost of champagne should not be weighed against a human life, and, if the patient tires of it, Rhine wine or dry Catawba may be substituted.

Trained intelligent women nurses are indispensable, and no others should be employed if they can be obtained. Woman is naturally gentle, tender, and deft, and if she be properly trained the moral effect of her ministrations is tremendous. She must not be overworked, and must be given time for rest and recreation. Her duties require the best exercise of her mental as well as her physicial powers, and so long as her patients are within the danger period her tour of duty should never exceed eight hours in twenty-four.

[1] Izett Anderson, Yellow Fever in the West Indies, London, 1898.

The old rule of withholding all nourishment from the patient so long as his temperature remains a degree above normal is an extreme measure. It is best to withdraw all food for the first three or four days; after that, if the temperature remains below 101° F., the stomach is in good condition, and food is craved, a tablespoonful of milk, with an equal quantity of Vichy or lime-water may be given at intervals of three or four hours, noting the effect. The patient's taste may be gratified by giving him cold wine or lemon jelly, pure frozen cream, ice-cold toast-water, or barley-water, any or all of them, in very small quantity and at long intervals. Gelatin is especially to be commended because it lessens the waste of cell proteins. Another remedy, olive oil, possessing the same power, has been used with great success by some of the older Spanish physicians. It is reported that out of 36 patients admitted to a hospital in Vera Cruz with black vomit, 30 recovered after inunctions with hot olive oil.[1] There is a rational physiologic explanation for this. Fat is a cell-food and protein saver. It is quite probable that the fat absorbed would help to restore the integrity of the hepatic cells and of the endothelial cells of the capillaries by affording them sustenance while performing the increased amount of work thrown upon them, thus preserving them from degenerative changes by doing away with the necessity for the consumption of their own protein material during the period of their excessive functional activity. The method is worthy of trial in severe cases and might prove especially valuable with children.

When black vomit supervenes, and particularly if it be associated with hiccough, the outlook is grave, but recovery may take place even after black vomit has set in.[2] In this condition treatment is usually of little avail; 10-drop doses of oil of turpentine every hour or two would seem to offer the best chances of success and to be directly indicated. Its stimulant, hemostatic, and diuretic properties certainly commend its use in these cases, which are characterized by marked depression, hemorrhages, and partial anuria. This remedy was highly spoken of by Dr. Benjamin Rush, who used it with success.

Frequently in the severer cases and those in which treatment has been delayed, attempts to administer remedies through the stomach weaken and distress the patient; they should then be given as high rectal injections, at short intervals, the fluid passing in very slowly to insure its being retained, if possible. Vichy water, normal saline fluid, or plain water, to the latter of which bicarbonate of soda (1 gm. to the pint) has been added, are probably the best. The fluid should be warm if the body temperature be low; cool, if it be high. It must be remembered that plenty of fluid is necessary to maintain the renal function. If the quantity of urine passed be small, it will be justifiable and safe to administer urea in this way (1 gm. in 250 cc. of water) by hypodermic injection or by hypodermoclysis (1 gm. in 500 cc. of normal saline fluid,

[1] La Roche on Yellow Fever, vol. ii, p. 724.

[2] Touatre states that persons over forty years of age with black vomit never recover. I have known a man of sixty-three to recover after profuse black vomit, when all treatment had been suspended and he had been given up to die.

containing 0.6 per cent. of sodium chlorid and a little sodium bicarbonate). With the kidneys acting fairly well, one might then administer small doses of alcoholic stimulants, oil of turpentine, warm fluid gelatin or olive oil (the latter emulsified by shaking with an equal quantity of lime-water), according to the indications.

Meddlesome medication in yellow fever is pernicious, but the treatment should never be strictly expectant, because a malignant poison is present, and cases, apparently mild at first, may manifest the gravest symptoms after only a few hours warning; the treatment, therefore, should be begun at the earliest moment, and it should be such as cannot possibly injure or weaken the patient. It should be directed along physiologic lines to insure constant elimination, chiefly by the kidneys, and to conserve the patient's strength and nutrition as far as possible. The disease is a self-limited one; its course is determined largely by the susceptibility of the patient and the previous condition of his vital organs. So long as the heart is acting well, the kidneys secrete plenty of urine, and the skin remains moist there is no cause for alarm; nevertheless, the most constant care and watchfulness are always necessary.

The complications, such as suppurative inflammation of the parotid gland, etc., should be treated on general principles. Partial suppression of urine calls for dry cups, urea, hot-air baths, hypodermoclysis; complete suppression means failure of the function of the liver and the case is hopeless; the former condition may be relieved. Heart failure should be met promptly with hypodermic injections of strychnin.

No solid food should be permitted until the temperature has remained normal three or four days, because a relapse may occur, and no chances should be taken. In the interval of normal temperature milk and thin chicken broth will be sufficient, at the same time continuing the jellies and ice-cream in slightly larger quantity, and with the addition of fresh, sound, juicy fruits. The administration of solid food should be begun with a soft-boiled egg and toast, chicken, chops, etc. Convalescence is usually rapid; albumin disappears from the urine, and the patient quickly regains his strength. In some cases albumin or casts, especially the latter, may persist in the urine for a month or longer, and the patient may not fully recover his strength for several months.

The use of mosquito-netting and other means for protection against the bites of mosquitoes should be continued until it is absolutely certain that the patient will not suffer a relapse, for with the renewed infection he would again, in all probability, become a source of danger.

DENGUE

By James Carroll, M. D.

Dengue or break-bone fever is an acute, infectious, and probably contagious disease, occurring, like yellow fever, in tropical and subtropical countries. It spreads with great rapidity, attacking nearly all of the inhabitants in a town or district, and in that respect it resembles influenza. It differs from influenza, in that it is nearly always accompanied by an eruption, is practically never fatal, and is followed by no severe complications. Cerebral complications are rather frequent in influenza and rare in dengue. The latter fever occurs during the warm season, the former in colder climates, and during the cool season of the year. Both are accompanied by coryza. Patients with dengue may resemble those suffering from slight attacks of yellow fever; the initial chill or rigor, swollen flushed face, cephalagia, fever, photophobia, and slightly coated tongue with red tips and edges, occur in both. In dengue the severity of the joint pains, with inability to move the limbs or head, the location of the pains in the head, the eruption resembling that of measles or scarlet fever, hyperesthesia of skin, and the general absence of albumin from the urine, are differential diagnostic points. The rigidity of the extension of the disease seen in dengue is impossible in yellow fever in the absence of previously existing cases in a susceptible community. The cases in which black vomiting has been reported were probably cases of unrecognized yellow fever, because this symptom is not recorded for large epidemics occurring in countries where yellow fever is known not to occur.

In the first day or two the case may closely resemble one of mild yellow fever, but the gastric disturbance is less marked; the expression of exquisite suffering upon the gentlest deep pressure in the epigastrium is not elicited; the albuminuria is lacking; the swollen, inflamed, sensitive joints are not found in yellow fever, and the temperature curve in the latter disease shows no such well-marked remission, lasting several days, as occurs in dengue. The first case or two may be of doubtful character, but the disease will extend with remarkable rapidity if it be dengue, and produce a sufficient number of cases to make its nature clear. Skin eruptions are rare in yellow fever and almost invariably present in dengue; the joint pains and stiffness persist in the latter disease and disappear promptly in the former; while second attacks are very rare in yellow fever, they are quite frequent in dengue fever, and, above all, an attack of the latter disease is almost never fatal. The

dusky hue of the skin of the chest in yellow fever, the disappearance of the same, and its slow return upon moderate pressure, is due to slowing of the blood in the capillaries. This is present early in yellow fever, but is absent in dengue. While vomiting may occur early in dengue, it passes off with the subsidence of the fever, and the vomitus never contains the fly-wing specks that indicate the approach of black vomit. The leukocytes in the blood are diminished, on the average, nearly one-half in dengue,[1] while the number remains normal, with an occasional polymorphonuclear leukocytosis of moderate or slight degree, in yellow fever. The period of incubation is usually from one to four or five days in dengue and practically the same in yellow fever.

The exact nature of the infectious agent in this disease also is unknown. The reports of the findings of parasites in the blood of patients suffering from dengue cannot be accepted, because they lack proper confirmation. A series of filtration experiments with blood might throw some light on the probability of its ever being found.

TREATMENT

In dengue the joint pains frequently attack the patient with such suddenness that he becomes stiff and helpless and must be assisted to bed. The pains are burning, boring, or lancinating in character, and when the patient is first put to bed he is unable to move, because almost any muscular movement causes pain. Coryza usually appears on the second day, and it may be accompanied by epistaxis. During the initial fever, when the temperature may reach 103°, 104°, or 105° F., cold sponging is necessary, and cold applications to the head afford the most relief. Cathartics should be avoided at this period, if possible, on account of the suffering that results from any movement of the body. If the pains are very severe morphin hypodermically, the bromids, or coal-tar preparations may be administered. Food is not desired, and cold drinks or milk and lime-water only are necessary during the first three or four days. After the second day, or with the decline of fever, the eruption appears on the hands, arms, trunk, and lower extremities, in the order named; the presence of the eruption is accompanied by itching or formication and followed by desquamation, after which the skin becomes hyperesthetic and the itching may be very annoying, especially on the fingers and toes. Simple palliative remedies are all that is required, *e. g.*, zinc ointment or carbolated vaselin. When the fever has subsided, and the appetite returns, jellies, creams, custards, and light nutritious food should be given, and at this time attention should be paid to the condition of the bowel. The patient should be kept in bed until desquamation is completed; then tonics, massage, stimulants, and nutritious food complete the cure.

[1] C. L. Van der Burg in Dr. Carl Mense's Handbuch der Tropenkrankheiten, vol. ii, p. 98.

INFLUENZA

By Alfred Stengel, M. D.

Influenza or grip is an infectious disease which has occurred in epidemics and pandemics at various intervals from the time of the first accurately described outbreak—that of 1510. The last great pandemic—that of 1889–90—began in the Orient or in Russia and swept over the world, eventually affecting every part of the globe. Since that time repeated smaller epidemics have occurred in different sections, and between these outbreaks and thereafter it has remained endemic in practically all parts of the world.

The specific cause of this disease is generally believed to be the bacillus described by Pfeiffer in 1892. This organism is a minute Gram-negative bacillus, which was found by Pfeiffer in great abundance in the sputum of affected persons, and was cultivated on artificial media containing hemoglobin, the latter being a necessary addition for the growth of the organism. In later epidemics, but particularly in the endemic cases now occurring, the organism has been found less abundantly and it often escapes detection. Not infrequently, endemic cases and small epidemic outbreaks of a disease clinically indistinguishable from influenza have yielded on bacteriologic examination no influenza bacilli, but only streptococci, pneumococci, or Micrococcus catarrhalis. Two explanations have been offered for this circumstance. Some maintain that rapid disappearance of the influenza bacillus, owing to previous partial immunization of the affected individual, accounts for the failure of bacteriologic search. Others hold that these cases are instances of infection with the other organisms named, and not true influenza, though clinically indistinguishable. Jochmann, who has made extensive studies of the etiology of the disease, suggests that the term influenza be reserved for cases in which the Pfeiffer bacillus is present, while the cases clinically indistinguishable, but in which that organism is not detected, should be called grip. Many clinicians are disposed to agree with this mode of tentative classification.

The bacillus of influenza has been frequently found in the sputa and secretions of the throat of persons not suffering from any symptoms suggestive of the disease. Thus, it has been detected in many cases of tuberculosis, bronchiectasis, diphtheria, measles, scarlet fever, and whooping-cough. It is not justifiable to regard every case in which Pfeiffer's bacillus is detected as one of influenza. Doubtless there are influenza-bacillus carriers among those suffering with chronic bronchial

and pulmonary affections, while in acute infectious diseases, like those named, local conditions in the throat, bronchi, etc., may favor the saprophytic existence of the organism. The occurrence of bacillus-carriers would explain the endemic continuance and the recurring epidemics following the great pandemic of 1889–90.

While the normal habitat of the influenza bacillus is in the respiratory passages, it gains access to the blood and occasionally gives rise to lesions in other parts of the body. The early claims of Cannon, that the organism is frequently found in the blood in acute cases, has not been sustained by later investigation, but occasionally instances of general infection, infective endocarditis, meningitis, otitis media, etc., indicate the possibility of hematogenous dissemination of the organism.

Sometimes a chronic bronchitis with the persistent presence of influenza bacilli follows after an acute attack. Such cases have been described as chronic influenza. Some investigators, however, insist that the organism in such cases remains as a saprophyte only.

The clinical features of influenza vary widely, and a number of types—such as (1) catarrhal, (2) nervous, (3) gastro-intestinal, (4) circulatory or cardiac, (5) typhoid—have been described, but there is generally a tendency to transformation in greater or less degree from one to the other. The onset is sudden, sometimes almost instantaneous, and is attended with severe headache and pain in the eyeballs, backache and pains in the limbs, rapid elevation of temperature, with acceleration of the pulse. From the beginning prostration is a conspicuous symptom and often is extreme. An irritative cough, coryza, or conjunctivitis may set in promptly, and such catarrhal symptoms may later increase out of proportion to the fever and general symptoms, and thus stamp the case as one of a catarrhal type. In this variety there is subsequently increase of bronchitis with more or less abundant expectoration, at first glairy mucus, later, mucopurulent material. After a day or two up to several days the temperature may rapidly decline and the symptoms speedily improve. In other cases the disease continues without relief or becomes more severe. Symptoms of general infection or intoxication, manifested by continuous high temperature and disturbance of the gastro-intestinal and other functions, may occur. A prolonged febrile bronchitis, with marked depression and sometimes extreme exhaustion, often follows an onset of no great severity. Pneumonia is not an infrequent complication.

In the nervous type, persistent intense headache, violent neuralgias, backache, sensitiveness to pressure, and pain in the extremities are common symptoms. Profound weakness and depression, and in a certain proportion of cases mental depression or aberrations occur, and may persist for long periods.

During the progress of epidemics of influenza cases of intense gastro-intestinal derangements, with or without fever, but accompanied by unusual prostration, suggest a gastro-intestinal type of the disease. It is difficult to prove the nature of these cases, but their relationship to influenza is quite probable. Marked nausea, vomiting, diarrhea, and sometimes intense pains in the abdomen are the most common manifestations.

In the typhoid type, fever is the most striking symptom. Occasionally the spleen may be enlarged and the general appearance of the patient may closely simulate that of one suffering from typhoid fever. Leukocytosis is absent, but the pronounced leukopenia usually found in typhoid is wanting. The abdominal symptoms are not unlike those of typhoid, but the characteristic spots and reactions of the blood are absent.

Circulatory or cardiac symptoms do not, as a rule, develop at the onset of cases of influenza of the circulatory type, but occur as later complications or sequels. The circulatory type is, therefore, usually developed from one of the others. Tachycardia, bradycardia, arhythmia, sometimes partial or even complete heart-block, may be met with. Endocarditis and pericarditis are rare complications.

A large number of less frequent complications and sequels have been described in influenza, but their rarity makes it unnecessary to mention them here.

TREATMENT

The infectious nature of this disease, and its tendency to epidemic occurrence, gives to the prophylactic treatment a greater degree of importance than has generally been bestowed upon it. The secretions from the bronchial tract are the main source of contagion, and should, therefore, be rendered sterile by the continued use of antiseptic solutions. The care of the sputum should be practically the same as that appropriate in tuberculosis of the lungs. In addition, local antiseptics in the form of gargles and sprays for the nose and throat may render some slight service.

In times of epidemic occurrence the young and old should be protected by isolation because of their greater susceptibility to intense forms of the disease. All persons suffering from respiratory diseases, and particularly tuberculous patients, should be guarded with especial care.

The problem of dealing with bacillus-carriers remains for future solution. At present, when such are recognized, the most rigid and constant disinfection of the sputum should be practised until the bacilli have disappeared. Perhaps the employment of vaccine therapy may aid in destruction of the organisms in such individuals.

Treatment of the Disease.—There is no specific remedy for influenza, and medical treatment practically consists of hygienic management and symptomatic medical treatment. No matter how mild the onset of the disease, the patient should be put to bed at once and kept there until convalescence has been fairly established. Observance of this precaution would doubtless obviate many regrettable complications, especially pneumonia and cardiac derangements.

Food should be regulated according to the conditions in individual cases. When fever is mild, the digestive organs not impaired in their functions, and the appetite, as is often the case, preserved, reasonably full diet should be permitted. In severe cases, however, with high fever, and especially in those in which gastro-intestinal disturbances

are present, a less ample dietary should be provided. Milk, cereals, milk-toast, beef-juice, broths, eggs beaten in milk or soft boiled, and, in general, the more digestible kinds of liquid or semiliquid foods, should be given. In cases of gastro-intestinal type, severe vomiting, loss of appetite, or diarrhea may interfere with suitable nourishment of the patient. The treatment in such cases should be directed with particular care toward increasing the patient's ability to take food, and the diet should be so regulated that no overtaxing of the impaired digestion may occur. In all cases of this disease it is important that the strength of the patient should be maintained, and to this end the amplest diet that can reasonably be given is appropriate. In many cases the feeding problem becomes more difficult during the later stages of the disease and in the convalescence. The weakened or exhausted digestion may at this time offer the most serious obstacles to recovery. Nourishing and easily digested foods are essential. Peptonized milk and various artificial food preparations, composed of milk or egg albumin with dextrinized or malted cereals, are especially useful. The various liquid patent foods, so rich in alcohol and poor in food value, are merely delusions and snares. Beef-juice, broths, or beef-extracts may stimulate the digestion, but are not alone of great value as foods. In some cases cod-liver oil and malted foods serve a useful purpose.

Relief of the early symptoms will often prove all that is required in milder cases, as the disease tends in many cases to terminate spontaneously within a few days, and in all cases, unless profound prostration is immediate, such symptomatic relief should be the first care of the physician. Small doses of phenacetin or antipyrin, alone or combined with salol, salicylate of soda, aspirin, or some other form of salicylate, frequently relieve the headaches, backaches, and neuralgic pains at once. Objection has been raised against the use of all of these remedies on the ground of their depressing qualities. Such objection is in order if large doses, such as are frequently given, are under discussion. Small doses, such as phenacetin, gr. 2 to 4; antipyrin, gr. 2; salol, gr. 2 to 4, and corresponding doses of the other remedies we have named, may be given every hour or two until several doses have been administered and then at longer intervals, with no danger of serious depression and as much likelihood of controlling the symptoms as would apply to larger doses. In some cases a single dose of Dover's powder, or the addition of a small amount of this to each dose of other remedies, aids in controlling the various pains of the disease. In tolerably severe cases, one or more hypodermic injections of morphin may be needed. Should a case of influenza become prolonged it is obvious that depressing remedies cannot be continued even in small doses without intermission. The writer has very commonly made use of the following combination:

℞. Salolis,
Acetphenetidinæ.....āā gr. iij;
Pulveris Doveri..... gr. ss.—M.
Ft. in capsule No. i.

The analgesic, antifebrile, and antiseptic properties of this combination seem to suffice for the control of symptoms and perhaps for actual cure of the infection. Certainly a notable proportion of cases of influenza during epidemics promptly yielded under this simple medication, with the addition of rest, care, and suitable diet.

The capsules should be given every two or three hours for two or three days, but if relief is not then obtained a more tonic and supporting plan of treatment should be adopted, with only occasional administration of analgesics, which, of course, in such case would be appropriately given in larger doses. The use of a small amount of Dover's powder at short intervals, as above advised, in addition to its aid and an analgesic, is designed to keep the skin moderately active continuously, and thus often has the happy effect of breaking up a tendency to occasional drenching and debilitating sweats.

A great number of analgesic and antifebrile remedies of the same class as those named might be mentioned, but none of these possesses advantages over the ones spoken of.

Local applications to the head, back, or other painful areas frequently aid in promoting the patient's comfort. Ice-bags, hot-water bags, spiced poultices, fomentations of various sorts and occasionally counter-irritant external applications, such as mustard plasters, may be useful.

The strength of the patient should be sustained by the use of tonics or stimulants when depression makes itself manifest. Strychnin, quinin in small doses, alcoholic stimulants, or aromatic spirits of ammonia are the best of such remedies. The first-named seems particularly useful when the continued support of a tonic and stimulant is required. Quinin has seemed to me especially advisable when catarrhal symptoms are prominent; 6 or 8 grains daily suffice for all purposes. Regarding alcoholic stimulants, much could be said in their disfavor, because the liberal use of these, and especially the undirected use by patients themselves, has frequently led to more harm than good. The free use of such stimulants is probably never desirable, but a small amount of brandy, whisky, or wine during the disease, but especially during the period of convalescence, and particularly in feeble patients or those advanced in years, may be given with advantage. Over-stimulation probably increases the after-depression of the disease.

The treatment of special symptoms arising in the different types must vary in accordance with the manifestations.

Treatment of the Catarrhal Symptoms.—In cases with early intense conjunctivitis, protection from light, the use of cold compresses when swelling and edema of the eyelids are marked, eye-washes composed of weak solutions of boric acid in camphor water, with or without the addition of a small amount of adrenalin chlorid or cocain, will probably suffice. Marked coryza requires alkaline antiseptic sprays, such as Dobell's solution or liquor antisepticus alkalinus, and adrenalin chlorid may be added if the congestion of the mucous membrane is excessive. An oily spray, composed of camphor and menthol dissolved in liquid vaselin, may sometimes be used with advantage after the cleansing alka-

line solution, or direct applications of ointments of camphor and menthol in vaselin may be applied to nasal passages.

Pharyngeal and tonsillar symptoms are, as a rule, less pronounced in the epidemic type than in the more recent endemic cases. Local treatment similar to that used in the case of coryza is sufficient, but in addition ice-bags to the sides of the neck, or, in case these are not well borne, hot applications may promote the patient's comfort. Astringent local applications, such as solutions containing tincture of ferric chlorid or nitrate of silver, are useful. Such solutions should not be too strong; tincture of iron with diluents 1 : 3, nitrate of silver in 1 to 2 per cent. solution suffice. If peroxid of hydrogen is used as a local application it too should be diluted.

The bronchial symptoms are the most trying of the catarrhal manifestations of the disease. Intense and repeated coughing may not only disturb the patient's rest and thus lead to weakness, but may tax the circulation as well. External warmth is usually desirable. Sedative cough mixtures, such as solutions of ammonium chlorid or carbonate or sodium benzoate, with ipecac, senega, or squill, and with the addition of heroin, codein, opium, or morphin, will usually aid in controlling these symptoms. Cases in which unusually tenacious sputa occur have appeared to me to yield most frequently to sodium benzoate or benzoic acid. The former may be given in solution or in various combinations as cough medicines. The latter in capsules, gr. v, taken after food or with a liberal drink of water. In cases in which bronchial or other secretions are abundant and watery, belladonna or atropin may be used with advantage. Guaiacol carbonate and terpin hydrate are sometimes useful in cases of protracted bronchitis after grip. Inhalations of steam, with or without the addition of tincture of benzoin, carbolic acid, eucalyptol, or some other aromatic antiseptic, may aid in allaying the irritation of severe trachitis or laryngitis, but quite as often fail.

It is a common experience to find that one after another combination to allay bronchial secretion and cough fails, until by lucky chance one seems to control these conditions. Occasionally external applications, such as stimulating liniments, vigorously applied to the back and chest may aid in controlling cough. A liberal coating of tincture of iodin may serve the same purpose. In some highly sensitive persons the protection and warmth of large flaxseed or kaolin poultices may serve an admirable purpose in controlling harassing cough. Protracted bronchitis, after the fever and acute symptoms have subsided, may prove most obstinate. General tonics, liberal feeding, moderate alcoholic stimulation, sometimes cod-liver oil, accomplish more than sedatives and expectorants. Far better than all of these in many cases is change of climate. Many such cases are immediately arrested by such a change.

Gastro-intestinal Type.—In the cases in which severe nausea and vomiting occur independently or in any type of the disease, counterirritants over the stomach, such as mustard plasters, spice poultices, or local applications of tincture of iodin may be very useful.

Small amounts of cerium oxalate, with fractional doses of cocain hydrochlorate and codein before food, may allay the gastric irritability and enable the patient to take sufficient nourishment. A preliminary course of calomel in small doses may be useful. Obstinate vomiting may yield to a hypodermic of morphin or an opium suppository, followed by local gastric sedative remedies.

Intestinal influenza usually takes the form of a severe serous diarrhea, and may require for its control repeated doses of bismuth or chalk mixture with more active astringents, such as silver nitrate, acetate of lead, and opium. It is important that this symptom should be controlled promptly on account of the danger of profound depression. The greatest care is necessary in the feeding of such cases.

Cardiac and Circulatory Type.—The cardiac derangements met with during or after influenza usually yield best to rest, general tonic medication, careful feeding, and time. Active medication is usually harmful. In cases of bradycardia and arhythmia the moderate use of atropin or belladonna may prove helpful, and when tachycardia and low pressure occur the cautious use of digitalis may be permissible.

When marked cardiac weakness occurs in the course of febrile or catarrhal types of the disease, the greatest care must be used to prevent additional weakening by excessive coughing, overfeeding, or exertion. Ice-bags over the heart may control subjective symptoms and perhaps act as cardiac tonics. Strychnin, aromatic spirits of ammonia, or moderate alcoholic stimulation may be used, and sometimes small doses of digitalis are beneficial.

The febrile or typhoid type of influenza must be managed along the general lines before indicated. It rarely is necessary to adopt active measures for the fever alone, but in some cases cold sponging, ice-bags to the head, or cold packs may give the patient considerable relief.

The after-treatment of the disease is often as difficult as the management of the acute stages. Care in diet, with a close study of the individual needs of the patient, is of prime importance, as few diseases leave in their wake such prostration as is common after sharp attacks of grip. Tonics are often distinctly useful, and the depression following their discontinuance not rarely demonstrates their value at once. Massage and tonic baths are useful aids in restoring the patient's strength. When convalescence is sufficiently advanced, change of climate may work wonders.

RHEUMATISM OR RHEUMATIC FEVER

By Alfred Stengel, M. D.

Acute rheumatism or rheumatic fever is an infectious disease which manifests itself by its tendency to involve the joints and serous membranes elsewhere. The local lesions in the joints are characteristic of acute inflammation. In the acute stages congestion with rapid serous or serofibrinous exudation occurs. When the disease becomes subacute or chronic, thickening of the synovial membranes and fibrous adhesions may be met with. Suppuration rarely takes place, either because the invading microörganisms are lacking in virulence or the local resistance destroys them. Similar lesions occur in the other serous membranes as a result of the rheumatic infection. The parts most frequently affected are the endocardium, particularly that of the mitral leaflets, the pericardium, and pleura; much less commonly other serous membranes are involved. The rheumatic nature of such lesions is admitted when they occur secondarily in cases of articular rheumatism. It is less easy to establish the rheumatic nature of a primary pericarditis, pleurisy, peritonitis, meningitis, etc.

The most serious sequel of rheumatism is that which results from involvement of the cardiac valves. In mild cases rheumatic endocarditis may undergo almost complete resolution, little beyond a slight thickening of the endocardium or valves remaining after the attack. Usually, however, considerable distortion of the valves from inflammatory thickening, adhesions, and secondary contraction occurs, and valvular defects are the result. The mitral valve is most frequently involved, the aortic leaflets being next in point of frequency; right-sided lesions are rare.

The cause of rheumatism has been a subject of discussion from the early history of medicine. Formerly, some special secretion or rheum was believed to be its cause. Subsequently, various chemical intoxications were thought to be the active etiologic factor, and among other substances various acids were assumed to be of importance. Among these, lactic acid and uric acid have held a high rank. The acid hypothesis was suggested by the pungent acid sweats characteristic of the disease, and by the highly acid condition of the urine. Later knowledge, however, indicates that these conditions are results rather than causes of the disease. Many circumstances make it now certain that this disease is an infection, and recent bacteriologic investigations throw some light on the microörganisms probably responsible. Several views have been entertained concerning the rôle

of certain microörganisms in the causation of the disease. Some have believed that there is no specific microörganism, but that the disease is a form of septicemia of a mild character and caused by staphylococci or streptococci. Others have insisted that some specific microörganism is the invariable cause. Among these an anaërobic bacillus, described by Achalme and other French observers, has been thought to be of importance, but the majority of recent bacteriologic studies indicate that the organism commonly present is a streptococcus or diplococcus somewhat allied to the Streptococcus pyogenes and the pneumococcus. This has been found in the blood of patients suffering from the disease and in the fluid obtained from the rheumatic joints. Its absence on bacteriologic examination of the fluid of the joints has been explained as due to the fact that the microörganisms have been destroyed, or have been retained in the tissues of the synovial membrane while the fluid exudate itself is sterile. This organism was named by Poynton and Payne the "Diplococcus rheumaticus," and these writers, with some other recent investigators, regard it as the specific cause of the disease. Injection of cultures into animals occasions lesions similar to those observed in man. The organism has among its properties the capacity of producing acid in unusual degree, thus explaining one of the characteristic manifestations of the disease.

It must be admitted that cases of undoubted rheumatism have yielded other organisms on bacteriologic study, and that the inoculation of animals with streptococci and other organisms derived from conditions other than rheumatism may produce lesions similar to those of rheumatism; that the etiology of rheumatism is, therefore, still uncertain. It seems, however, that in the majority of cases of accurately studied rheumatism an organism closely similar, if not identical, to the Diplococcus rheumaticus has been found. The position that may be most properly maintained regarding the etiology of rheumatism is closely allied to that which must be held with regard to the etiology of pneumonia, which, though usually caused by the pneumococcus, is admitted to be the result also of infection with other organisms in a minor proportion of cases.

Apparently local conditions, environment, diet, etc., play some part in predisposing individuals to this form of infection, and there is in many cases a strong hereditary predisposition to the disease. Injury of the joints may act as a localizing cause. This explains the greater frequency of onset of the disease in the joints of the lower extremities, especially the knees and ankles.

Other forms of infective anthritis. Some of the difficulty regarding the etiology of rheumatism is due to the fact that there is as yet no absolute criterion by which the diagnosis of the disease may be established with certainty. It is known that in acute infectious diseases, like scarlatina, variola, typhoid fever, dysentery, septicopyemia, polyarthritis may occur, which in its outward manifestations resembles that of rheumatism so closely that a diagnosis can only be made when the preceding disease has been recognized. Only slightly less confusing forms of arth-

ritis may occur in connection with gonorrhea, syphilis, tuberculosis, and the hemorrhagic diseases, purpura, scurvy, and hemophilia. Finally, there are cases of arthritis arising without recognized preceding disease, which in their general manifestations differ somewhat from typical rheumatism, and which, therefore, have been separated from that disease. Among these is the type described by Still in childhood. In earlier days a confusion arose in differentiating rheumatism from gout and rheumatoid arthritis, and even at the present day it is often difficult to make a proper diagnosis. For these reasons the ultimate solution of the etiology of rheumatism has been beset with difficulties and it is impossible to dogmatize too strictly.

A matter of great importance in the study of the etiology of rheumatism has been the probable source of the infection or the portal entrance to the body. It has been asserted by a number of clinical observers that tonsillitis and inflammations of the throat precede the disease with great regularity, and cases of sudden and intense rheumatism following after a throat infection of more than ordinary gravity have frequently been reported. Other cases have been described in which rheumatism has followed after infective lesions elsewhere, such as subcutaneous lesions following infected sores or injuries. It is commonly believed by clinicians that an infection of the throat usually precedes rheumatism, though definite proof of this assertion can hardly be claimed as established.

TREATMENT

Prophylaxis.—To a limited extent preventive treatment or measures may be applied to rheumatism with a prospect of fulfilling a useful purpose. Certain predisposing causes, such as exposure to cold and dampness, living in damp and ill-ventilated houses, and bad drainage, may be obviated, and demand consideration on the part of those who have ever suffered from a rheumatic attack. Certain occupations, such as those which require frequent exposure to cold and wetting, and especially those which require workmen to go in and out of cold-storage rooms, are particularly dangerous to rheumatic persons. If the conditions cannot be changed, great care should be taken by the individual that sudden chilling may be avoided as much as possible or counteracted by suitable clothing. The ease with which recurring attacks are brought on in persons who have had several previous seizures should suffice to indicate the desirability of a more suitable occupation for those whose work requires much exposure of the kinds mentioned.

Care of the pharynx and tonsils may perhaps avail to prevent rheumatism in some cases. Aside from other reasons for appropriate treatment of catarrhal conditions in the throat, the possibility of preventing rheumatic infection would justify any time and trouble bestowed in such treatment. Unquestionably, when large tonsils, with open crypts or pharyngeal catarrh, are found in individuals who have suffered from preceding attacks of rheumatism, such conditions should be most carefully treated. It may be doubted whether present knowledge justifies

the wholesale removal of tonsils in persons who have suffered from rheumatic attacks without reference to the local conditions in the throat; but surely enough suspicion attaches to the throat as a probable portal of entrance of infection to warrant treatment and perhaps surgical interference in suspicious cases.

Treatment of the Attack.—The important elements in the treatment of a rheumatic attack are rest, diet, and medicaments.

Rest.—At the very outset of rheumatism the patient should be put to bed, and he should remain there until all acute symptoms, at least, have subsided, and usually until all local symptoms, as well as fever and constitutional symptoms, have vanished. This course of action will doubtless cut short many cases that otherwise might drag on and become chronic, but it is even more desirable, on account of the danger of cardiac complications, when an opposite course is followed. The old adage that "blankets and six weeks" summarize the necessary treatment has lost much of its force, in so far as it indicates probable uselessness of any medical treatment, but it properly emphasizes the importance of rest. Rest in bed has a triple advantage in rheumatism. It, in the first place, secures the condition most desirable for any febrile disease with the attendant waste of tissue occasioned by fever; but of even greater advantage is the fact that while quiet and in a horizontal position blood-pressure and cardiac action are reduced, and thus the danger of cardiac complications somewhat lessened. It has been quite conclusively proved that the mechanical injury of the heart valves incident to overaction of the heart is an important precedent condition to rheumatic or other infections of the valves. A third reason for rest is that this puts the affected joints in the best condition for subsidence of the local lesion, and thus promotes the patient's comfort and hastens his recovery. Doubtless, undue movement of rheumatic joints may readily increase the liability to cardiac complications by exciting greater local trouble in the joints.

The old plan of requiring a rheumatic patient to lie between woolen blankets may be advantageous in some cases, but is not sufficiently important to warrant its invariable adoption. With suitable modern nursing the patient's clothing and sheets can be changed without danger of chilling and with little disturbance. When such aid is not available, and the patient suffers from profuse sweating, woolen sheets may be advisable.

Local rest, that is, rest of the joints, may be secured by bandaging over cotton wadding, by splinting, or by the use of fixation dressings of other sorts, such as silica or plaster casts. The advantage of such local rest cannot be overstated. While the primary application of such dressings may seem to be too disturbing, the after-effects are so satisfactory that the first discomfort is speedily forgotten. A thick layer of cotton over the joint, fastened by a loosely applied bandage, is often sufficient, but is far less useful than splints and casts. In comparative tests of different joints in the same patient I have a number of times found rapid improvement in those put at complete rest by casts,

while others not so treated continued swollen and painful. In several cases I have seen quite severe local manifestations and secondary fever subside with surprising rapidity under such management. The objection to casts, that they do not permit of local applications of lotions, etc., to the joint, may be obviated by applying the cast to the joint after it has been liberally padded with bandages and then splitting the cast. In this way I have been able to keep the affected joints thoroughly splinted, while, at the same time, using local applications over the joint within the cast.

Diet.—The prevailing idea regarding the harmfulness of acids, meat, and generous diet of all sorts in cases of rheumatism was originally suggested by the erroneous assumption that some acid, lactic or uric for example, is the cause of the disease. While this hypothesis of the etiology is no longer tenable, it is quite possible that the kind of diet it suggested may be desirable, and certainly clinical experience justifies the belief that restricted diet is desirable and that overfeeding is never advantageous in the acute stages of the disease. On the other hand, one may very well question the wisdom of pushing restrictive measures too far, and especially in cases of highly infective type, in which anemia becomes pronounced, continued abstinence from proteid food is distinctly harmful. In certain cases of rather obstinate type, with mild but persistent involvement of the joints and continuous wasting of the body, no improvement will occur until the patient has been liberally nourished. The combination of starvation and long continuance of depressing remedies in such cases does far more harm than even an excess of food could do.

In acute cases of rheumatism, milk, up to about 2 quarts daily, with carbohydrates, such as bread, rice, and other cereals, butter and cream, and perhaps one or two eggs daily, will suffice. If digestion is not impaired the feedings should be four or five daily; if the stomach will tolerate only very small amounts of food, the feedings should be every two, two and a half, or three hours, and the quantities accordingly reduced. Experience in each case must, however, govern this matter.

When the acute stages of the disease have passed, and the patient has been considerably reduced and rendered anemic, the desirability of giving more ample diet, and especially meat food, must be considered. To persist obstinately in withholding meat, notwithstanding the fact that the patient is growing more and more anemic and enfeebled, is a bad policy, without justification in any known facts regarding the nature of the disease. Moreover, clinical experience will demonstrate that the opposite course is advisable in such cases. It is well, however, to act cautiously, for, as has been said before, overfeeding is undesirable.

In the cases of obstinate but mildly infective type, in which more generous diet is required than in the acute cases, I have found that meat-juice freshly prepared, some red meat, with chicken or birds, and occasionally cod-liver oil, may be added with advantage, and when the wasting of the patient is a conspicuous feature, a generous mixed diet is advisable. Sometimes the addition of malted liquors or other alco-

holic stimulation serves to aid in increasing appetite and digestion. It must be recalled that reference is now made to subacute or chronic types of rheumatism with little or no fever, not to bed-ridden febrile cases.

Medicinal Treatment.—Salicylic acid in some form has been employed in the treatment of rheumatism for many years, but opinions still differ widely as to its effect and value. At first it was looked upon as a specific, and even now many hold this view. Unquestionably, the effect it manifests in controlling the pain of rheumatism must be regarded as in some sort specific, but it cannot be claimed to exercise an equally specific influence over the infection itself. Cases of rheumatism treated with salicylic acid or its compounds, while relieved of suffering are not materially shortened in their clinical course, nor do the endocardial lesions seem less frequent in series so treated than in those not treated in this manner. Indeed, it has sometimes appeared that endocarditis occurred more commonly in such series, a fact which might perhaps find an explanation in the greater amount of movement of joints made possible by the relief of pain.

Whether a true specific or not, salicylic acid is indispensable in the treatment of the disease. It was first used in the form of salicin, a glucosid containing salicylic acid, derived from willow bark. Later, salicylic acid itself was employed, either that derived from natural sources or synthetic. Still later, salts, such as the sodium, strontium, and ammonium salicylate, were used, and in recent years a number of compounds containing salicylic acid have been introduced. Among these salol, aspirin, and novaspirin are useful in certain cases; and methyl salicylate or oil of wintergreen which contains the same, is occasionally of advantage internally or locally.

Free salicylic acid is rarely used at the present day because it is highly irritating to most stomachs, and possesses no advantage over the salts or synthetic compounds. The natural acid is somewhat less irritating than the synthetic, but not sufficiently so to give it preference over the salts.

My own experience makes me prefer salicylate of soda over all other preparations. It should be given in solution, well diluted, and it is advantageous to administer an equal dose of bicarbonate of soda after the salicylate for the purpose of neutralizing any liberated salicylic acid. The following prescription is a useful one:

℞. Sodii salicylatis ..... ℥ss;
Aquæ menthæ piperitæ ..... f℥iv.—M.
Sig.—Two teaspoonsful well diluted every two hours.

When the quality of the obtainable sodium salicylate is doubtful, a solution may be prepared by dissolving in water the desired dosage of salicylic acid and neutralizing the latter with bicarbonate of soda. Ammonium salicylate may be prepared in a similar manner, but possesses no advantages. Sodium salicylate should rarely be given in capsules or tablets. To do so is to invite gastric disturbance. Those

who make use of the method above described will rarely have occasion to seek for new preparations supposedly less disturbing, but it must be admitted that occasionally salol or aspirin is tolerated when the solution of sodium salicylate is not. The reverse, however, occurs with equal or greater frequency.

Salol or phenyl salicylate is in small doses unirritating, but in larger doses may disturb the stomach or bowels. It passes through the stomach, for the most part, unchanged, and is decomposed in the upper bowel, forming salicylic and carbolic acid. In large doses the formation of carbolic acid is a disadvantage and even a danger. Salol has the advantage that it is a powder, properly administered in capsules or tablets. The latter, however, frequently remain intact and are passed from the bowel.

Aspirin, acetyl-salicylic acid, is a newer substance that has the advantage over salol that no dangerous by-product results from its decomposition in the bowel. It is an insoluble powder, which is best given in capsules. The claims that aspirin and salol do not disturb the gastro-intestinal tract are unfounded. In many cases, when the dose corresponds to that in which sodium salicylate is administered, the disturbance of stomach and bowels is equally great.

Oil of wintergreen and methyl salicylate have always seemed to me more irritating to the stomach than the other preparations mentioned. Even in weak emulsions it may be quite disturbing, and the odor is objectionable after a time. Methyl salicylate, and some other more or less volatile synthetic compounds containing salicylic acid, are often used locally over the joints with some benefit, but there is too little absorption through the skin to have any general effect.

Dosage.—The amount of salicylic acid or its compounds properly administered in cases of rheumatism is a subject of considerable difference of opinion. Undoubtedly, the middle ground is safest. European writers often advise doses which I have seen cause delirium and other severe toxic manifestations, while, on the other hand, the overcautious recommend quantities too small to be of any use. An average-sized adult, without special susceptibility, readily takes from 60 to 90 gr. in twenty-four hours, and may continue such doses for a few days, but it is wiser to reduce the amount after forty-eight hours, especially if the patient has become more comfortable. Fifteen grains of salicylate of sodium every two hours during the waking day may be used as a safe dose, that may be exceeded in the stronger and more tolerant. Ringing in the ears, gastric disturbances, cardiac irregularity or weakness, or other toxic manifestations demand the immediate reduction of the dose or cessation of the administration, whether large or small amounts have been used. No advantage over the disease is gained by persisting in toxic doses. After two or three days of active exhibition of the drug, and especially when the acute symptoms have ameliorated, the doses should be reduced to one-half or even one-third of those given before, and the administration in this amount may be continued for a considerable time, even for two or three weeks. As a general rule, how-

ever, I believe it is better practice to discontinue the remedy after a week if the patient's condition permits this, or if the pains can be controlled by other remedies, so that after a suitable intermission another course of rather free doses may be given. Long continuance of salicylates in any form is undoubtedly depressing, and may possibly cause renal or other troubles. It is certainly injurious to digestion.

In some cases of rheumatism only the largest safe doses have any effect, and sometimes even such amounts fail to control pain. In these latter, it is unwise to go beyond safe doses, but some adjuvant should be employed. One of the analgesics, such as antipyrin, acetphenetidin, or acetanilid, may be used, the first two in doses of from 3 to 5 gr., four or five times daily, the last in somewhat smaller amounts. Some patients will tolerate larger doses, but in combination with salicylates these doses are usually fully ample. The addition of sodium bicarbonate and caffein to acetphenetidin or acetanilid, as in the officinal compound acetanilid powder, seems to increase the efficiency of these drugs. The effect of these remedies must be even more carefully watched than that of salicylates, particularly when there is cardiac weakness of any sort.

All of the remedies mentioned, the salicylates as well as the analgesics, may increase the patient's tendency to sweating. This is not a necessary condition to their effectiveness, and may sometimes be checked without disadvantage by the use of small doses of atropin, agaricin, or picrotoxin. Proper care of the skin and clothing is likewise beneficial. Partial alcohol baths or applications of solutions of alum in alcohol are refreshing and otherwise useful.

Sometimes the pains of rheumatism are so intense and so little influenced by the remedies mentioned that sleep is impossible and the patient becomes demoralized. In such cases opium or morphin becomes necessary. The timely use of an opium suppository, or a 10-gr. Dover's powder, or a hypodermic injection of morphin may produce rest and sleep and prevent physical and nervous exhaustion. It is, of course, desirable to guard against too frequent use of such remedies on account of their unfavorable effects and the readily acquired dependence.

In cases of severe and protracted rheumatism the difficult problem presents itself to the physician, How long and how freely should salicylates be administered? If the plan I have suggested, of suspending the remedy from time to time, is followed, the difficulty is less pressing than when continuous administration is practised. Even, however, when intermittently used one finally reaches the point when the prolonged exhibition of salicylates seems questionable. The fact that such a point is reached is, of course, an evidence that the drug has exercised and is exerting no other than an ameliorating influence, and if the pain can be controlled in some other way, or is not intolerable, a prolonged discontinuance of the drug or its permanent withdrawal will do no harm. As a rule, when this difficulty is encountered the patient will have become considerably exhausted and anemic, and, therefore, in need of tonics and restorative remedies. It is in such cases that more

ample feeding may become necessary, and among the tonic remedies iron, arsenic, and strychnin are valuable. Blaud's pills, with or without arsenic, or Basham's mixture, may be used. It has sometimes seemed to me that small doses of bichlorid of mercury (gr. $\frac{1}{100}$ to $\frac{1}{50}$) acted beneficially in cases of this sort.

Serum-treatment, etc.—Attempts have been made to find some sort of specific treatment for rheumatism, in the form of sera and other biologic products, but thus far no real advance has been made in this direction. Antistreptococcus sera have sometimes been used, with, however, no certain result. The general untrustworthiness of antistreptococcus serum is acknowledged by most investigators, and applies in the case of rheumatism as in other diseases due to streptococci or allied organisms. I, myself, thought some years ago that in a few cases of obstinate and relapsing rheumatism, in which antistreptococcus serum was used, an impulse toward recovery was given by the treatment, but the cases were too few and the factors of possible error too many to warrant deductions. Vaccination treatment may, perhaps, give useful results, as it has in cases of gonorrheal rheumatism. The future must decide this.

Alkaline Treatment.—The administration of alkalies in the treatment of rheumatism originated at the time when acids were regarded as of etiologic significance, and the perpetuation of the method is largely due to the fact that the acid sweats and highly acid urine seem to demand neutralization. Many who have no belief in the etiologic importance of acids still hold to the alkaline treatment, because of its neutralizing effect, and there is nothing illogical in such practice. Moreover, clinical experience seems to show some undoubted efficacy of such treatment. Few, if any, would at the present time discard salicylates for alkalies, but the latter as adjuvants to salicylates seem desirable in most cases and almost essential in some. Among the alkalies that are especially useful the bicarbonates of potassium and sodium should take first rank. Other potassium salts, such as the citrate and bitartrate, are also useful, and may have a slight advantage in being more diuretic. The bicarbonate may be used in conjunction with salicylates, with the added advantage that they neutralize any free salicylic acid liberated from the salts or compounds containing it. Some clinicians advise the administration of alkalies in doses sufficient to render the urine neutral or alkaline; others recommend liberal doses, without demanding such a result. In any case, the dosage must be governed by the gastrointestinal tolerance of the patient. If no digestive disturbance arises the doses may be increased to any reasonable degree; 10 or 15 gr. of the alkaline bicarbonate every two or three hours will usually cause no disturbance; the neutral salts may be given more freely.

Local Treatment.—Apart from the local measures to secure rest for inflamed joints, which have been sufficiently discussed, various local applications are desirable for relief or for curative purposes. Hot or cold applications may be employed in the acute stages of the disease, in accordance with the tolerance of the patient. Sometimes one, some-

times the other, is more acceptable; neither is probably curative in its effects, except perhaps prolonged applications of ice-bags, which are usually intolerable. Fomentations, cloths kept moistened with lead-water and laudanum, or saturated solutions of magnesium sulphate, and various ointments or oily applications, containing such substances as oil of wintergreen, methyl salicylates, mesotan, camphor, menthol, or ichthyol, may be used for their local anesthetic effects. None of these have seemed to me to offer special advantages over cotton-wadding with fixation. If any of the remedies named is preferable above the others, my experience would indicate ointment of methyl salicylate (10 to 20 per cent.), menthol and camphor ointments (each 10 to 15 per cent.); mesotan or ichthyol ointments of equal strength, may be used. In all cases the ointment should be applied on lint or several layers of flannel, and covered over with oiled silk or paper and a moderately firm bandage. Too prolonged application of such ointments may occasion undesirable irritation of the skin.

In cases of subacute rheumatism, iodin, repeated small blisters or dry cups, may be used to promote local congestion and absorptive processes. In cases of unusually abundant serous exudation aspiration of the joint may be required, but this procedure is never to be undertaken without deliberation nor before the effusion has manifested a tendency to remain unabsorbed.

Treatment of Complications.—The most important of the complications of rheumatism are those affecting the heart. The careful clinician will be ever on the alert to detect the first evidences of cardiac lesions—endocardial, myocardial, or pericardial; but even before such evidences present themselves steps will be taken to make their occurrence unlikely. Rest, general and cardiac, is essential. Overaction of the heart undoubtedly favors cardiac complications. At the first sign of trouble ice-bags should be applied to the precordia and blisters should be employed. The value of the latter is uncertain, though clinical experience seems to indicate that they are helpful in endocarditis and pericarditis. Salicylates seem to have no power to prevent cardiac complications nor to aid in their cure. Absorbents, such as mercurials and iodids, have been employed in cases of endocarditis and pericarditis, but are of doubtful value. Digitalis and other cardiac stimulants serve no useful purpose, unless there is great weakness of the heart, and often they may do harm. The so-called sedatives of the heart—aconite and veratrum—exert no useful effect on the heart itself, and may cause undesirable general depression. Rest, ice-bags, and other local applications over the heart and general sedatives are the best remedial agents. Aside from these, treatment should be directed to ensure the most wholesome state of the gastro-intestinal tract, and the diet should be so advised that overfilling of the stomach does not occur, and that the volume of the blood is not increased by the drinking of excessive amounts of liquid.

Nervous Complications.—Restlessness, sleeplessness, and general nervous demoralization are usually the result of pain, and must be combated by remedies directed against this symptom. At times mild

sedatives, such as bromids or valerianates, or hypnotics, such as trional or veronal, may enable the patient to secure quiet and rest with smaller amounts of the more powerful analgesics than would otherwise be necessary. "Cerebral rheumatism" is the name applied to forms of the disease in which intense cerebral symptoms occur, with or without high fever. The actual basis of such symptoms may be toxic cerebral irritation, congestion of the brain and meninges, or actual meningitis. Ice-bags to the head, leeches applied to the back of the neck and occipital region, venesection, rather free purgation with blue mass or calomel, and cerebral sedatives are desirable measures of treatment. Hypodermic injections of morphin or hyoscin may be needed in severe cases, but in the milder ones simple sedatives, such as bromids, valerianates, camphor, etc., are sufficient.

Hyperpyrexia may occur in conjunction with intense restlessness, delirium, or coma. In these cases the temperature reaches an elevation of from 106° to 109° F., or more. Ice-baths or packs are imperatively necessary, and ice-bags should be kept applied to the head. Antipyretic drugs are dangerous, causing a fall of temperature in some cases, but such depression that the advantage is too dearly bought.

Treatment of Convalescence.—It is often very difficult to know when convalescence has been sufficiently established to allow the patient to leave his bed, and relapses or recurrences are easily brought on. When the temperature has become normal, and has remained so for some days, and when, at the same time, all evidences of acute inflammation of the joints have disappeared, the patient may be allowed out of bed; but, in the opposite case, he must be kept at rest, even though the full recovery is tedious. In protracted cases nutritious food and tonics may be needed to restore the patient's strength and resistance. Finally, some change of climate, preferably to a warmer and more equable one, may be desirable. Not rarely massage and passive movements may be a useful aid in restoring the joints that have become stiffened as a result of the disease and the inactivity.

TETANUS

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Tetanus, an infectious disease, is caused by a specific microörganism (Bacillus tetani) that enters the body through a wound. The bacillus grows in the tissues at the site of the inoculation, developing a toxin, which, after a variable period of incubation, produces the characteristic lesions of the disease. Experimental evidence shows that the toxin has a selective chemiotaxis for nervous tissue, and that the route of its diffusion from the seat of the infection is first by way of the nerve-fibers.

The length of the period of incubation is an important factor in determining the severity of the disease. The longer the time between the infliction of the wound and the onset of the symptoms, the milder will be the course of the disease and the more amenable it will be to therapeutic measures. Nine days is the period of incubation that makes the distinction between acute and chronic tetanus, and marks the probable severity of the disease. Hippocrates says that those who live four days after the development of convulsions recover.

TREATMENT

The treatment of tetanus divides itself into the preventive and the curative. In each division, local as well as general measures are employed. Certain varieties of wounds are prone to give access to and encourage the development of the tetanus bacillus. The organism is an anaërobic one, found in large numbers in garden soil, street dirt, the dust of old walls, and in stable refuse. Punctured wounds, especially when made by implements contaminated with soil or street dirt, gunshot wounds, those of toy-pistol and fire-cracker accidents, and wounds received about stables or animal shelters, are very likely to be infected by the tetanus organism, and, therefore, in handling such wounds the preventive treatment should be instituted at once.

Preventive Treatment.—*Local Measures.*—Suspected punctured wounds should be laid open by free incision, and the depths of the wound cavity disinfected by means of pure phenol and alcohol or tincture of iodin. Foreign particles should be removed from the wound. The powder obtained by drying antitetanus serum is then used for dressing the wound, or the cavity may be filled with the fluid serum and a moist antiseptic dressing, for example, a wet boric pack, loosely applied. Kitasato was able to produce immunity in animals by subcutaneous injections of iodoform. This drug is, therefore, useful in dressing suspected wounds.

Excision of the wound area with a surrounding zone of healthy tissue, when practical, is better than simple incision. The resulting wound is to be disinfected and treated as above. These wounds should always be left open and allowed to heal by granulation, the dressing and packing being changed daily.

Brockenheimer[1] advises the local use of lipoid substances, especially balsam Peru ointment, which he found by experiment had the property of prolonging the period of incubation.

Brockenheimer also advises the following routine treatment in suspected wounds:

(1) Cleaning and washing out with hydrogen peroxid solution, since this checks the growth of tetanus bacilli.

(2) Application of balsam Peru ointment to prolong the period of incubation.

(3) The daily use of antitoxin during the doubtful period.

Prophylactic Injection of Antitetanic Serum.—Serum therapy of tetanus has its best results in prophylaxis. By the routine use of this method in the treatment of Fourth of July accidents several observers report material reduction of the number of cases of tetanus following toy-pistol wounds, and a great mitigation of the severity of the symptoms and diminished mortality in the cases that have developed. This serum is not bactericidal, but acts by neutralizing the toxin. The prophylactic dose of the serum is 1500 units, administered subcutaneously, and this quantity should be given subcutaneously at once as a routine method of treatment in dealing with suspected wounds.

Curative Treatment.—The cure of tetanus after the disease has been established depends on the ability of the patient to combat the local effect of the toxin on his central nervous system, and the degree of endurance with which he can withstand the enormous muscular work of the convulsions. Certain principles for the treatment of the disease may be based on this fact; these principles are:

(1) The maintenance of the bodily vigor of the patient by proper nutrition.

(2) The limitation of the frequency and the force of the convulsions.

(3) The neutralization of the toxins present in the nervous system and the body fluids.

(4) The removal of the source of supply of these toxins, if possible, by appropriate treatment of infection atria.

General Treatment.—The patient is put to bed in a quiet, well-ventilated, darkened room. As far as possible all peripheral irritation must be prevented. The bowels are kept open by salines or other purgatives and enemas if required. Retention of urine may occur and necessitate the use of the catheter. Salt solution, subcutaneously or, better, by the rectum, using the drop method, should be given. By the latter route 500 cc. every six hours may be administered for several days without inconvenience.

Maintenance of nutrition is the most important general measure.

[1] Archiv. f. klin. Chir., 1908; and Amer. Jour. Med. Sci., Jan., 1909.

Feeding is often difficult on account of the dysphagia or the onset of convulsions when swallowing is attempted. If the patient can swallow, a diet of concentrated liquid food should be given, but when this is not possible, rectal feeding becomes necessary. A very good plan is to mix the nutrient enema[1] with the salt solution and give it by the drop method.

Drugs.—Potassium bromid and chloral hydrate are the best. Large doses are to be given, 40 to 60 gr. of the bromid every four to six hours, with half this quantity of chloral, administered either by mouth or by rectum. Morphin, hypodermically, in doses of from $\frac{1}{8}$ to $\frac{1}{4}$ gr., should be given before making any dressings or before the use of the catheter, etc.

Chloroform acts differently with different patients. There are a number of cases reported where the patient was kept under the influence of this drug for several hours, or even days, and finally recovered. On the other hand, many competent observers, more particularly George Murray Humphrey,[2] feel that after chloroform the convulsions become aggravated and the patient weaker, as though the remedy diminished his resistance. Severe, and occasionally a fatal spasm, may be induced by the administration of chloroform. Our present knowledge of the action of chloroform makes its prolonged use unjustifiable.

Chloretone.—Willard Hutchings[3] recommends this drug. From 30 to 75 gr. are given at a dose, and this is repeated until the patient sleeps. The drug is administered by mouth dissolved in whisky, or by the rectum in olive oil solution. The latter method is the better one.

Phenol (Hypodermically, Baccelli's Method).—The wound is cleaned and thoroughly disinfected by means of strong antiseptics; 1 cc. of a 2 per cent. solution of phenol in water is given every two or three hours, as required to control the convulsions. In mild cases the dose should not exceed $\frac{2}{10}$ gm. phenol in the first twenty-four hours, but the daily quantity is to be rapidly increased to two or three times this amount.

Atropin.—This drug is of some value in controlling the convulsions, and should accompany morphin whenever the latter is given. The principal value of atropin is in the prevention and relief of the distress due to an oversecretion of mucus in the air-passages.

Magnesium Sulphate (By Intraspinal Injection).—This method is an application of the researches of Meltzer and Auer on the inhibitory action of magnesium on the body processes. These observers found, among other results, that the intraspinal injection of a 25 per cent. solution of magnesium sulphate produced anesthesia and paralysis of the posterior extremities in monkeys.

Blake[4] and Miller[5] report the use of this drug in the treatment of tetanus.

[1] This nutrient enema is prepared by mixing 200 cc. peptonized milk with two eggs and enough salt solution to make 500 cc.

[2] Allbutt's System of Medicine, vol. i.

[3] Annals of Surgery, July, 1909.

[4] Surgery, Gynecology, and Obstetrics, 1906.

[5] American Journal of Medical Sciences, December, 1908.

The dose employed is 1 cc. of a 25 per cent. solution for each 25 pounds of body weight. This quantity, shown by Meltzer to be about one-third the lethal dose for monkeys, is injected into the spinal canal after drawing off a corresponding amount of cerebrospinal fluid by lumbar puncture. Relaxation of the spasm occurs in a few moments and lasts for several hours or even for days. Whenever rigidity becomes marked or convulsions recur, the injection should be repeated. In Miller's case 11 injections were given, at intervals varying from twenty-five to forty-two hours.

Technic—The patient is placed on the operating table, in the lateral semiprone position, the shoulders and pelvis brought forward so as to increase the convexity of the spine. The head end of the table should be slightly elevated. If the rigidity or convulsions prevent these manuvers, ether or nitrous oxid and oxygen should be given to secure relaxation.

The lumbar region is shaved, scrubbed with soap and water, followed by ether and alcohol in succession, and these in turn by corrosive sublimate solution. In an emergency this operative field may be prepared by painting the dry skin with tincture of iodin twice at fifteen-minute intervals. The field is now protected with sterile towels. The operator in the meantime disinfects his hands, using soap-and-water scrubbing, followed by alcohol and bichlorid solution.

The spinal canal is opened through a lumbar puncture, made by introducing a long aspirating needle between the bodies of the third and fourth lumbar vertebræ. The needle goes through the skin ½ inch outside the spine of the fourth lumbar, passes upward and inward through the intervertebral cartilage, and punctures the membranes of the cord.

A successful puncture of the membrane is shown by the immediate flow of clear cerebrospinal fluid. The rapidity of this flow depends on the degree of intraspinal pressure. The amount of fluid drawn off should correspond to the amount of magnesium solution to be injected. The syringe containing the magnesium is then connected with the aspirating needle and the solution slowly injected.

When repeated injections are made, the cerebrospinal fluid is likely to become cloudy.

Respiratory collapse may occur after the injection. The patient, therefore, should be left in charge of a competent nurse, and preparation should be made for practising artificial respiration if this becomes necessary.

Serum.—The damage produced by the tetanus toxin is due to a chemical combination of this substance with the ganglion cells of the nervous system. It follows, therefore, that in order to decompose this combination the antitoxin must reach the nervous system in concentration and quantity sufficient to exert a mass action. For this reason subcutaneous and intravenous injections of antitetanic serum have not given good therapeutic results. Such injections can only influence the toxins in the blood or lymphatics, a quantity shown by experiment to

be relatively small. Therefore, the serum is given directly into the central nervous system, either by lumbar puncture, or, better still, by intraventricular injection. (It is significant that the large accident insurance companies include these injections in the list of surgical operations for which they agree to pay a fee.)

Intraventricular Injection.—A skin and periosteal flap is reflected from the anterior portion of the skull and the cranium opened by a small trephine, about an inch from the bregma, just behind the coronal suture. Through this opening a long needle is passed vertically, 2 or $2\frac{1}{2}$ in. into the brain substance. When the ventricle is reached fluid will flow from the needle. The serum is then injected slowly; 1500 units is the usual dose, repeated if the convulsions continue.

Intraspinal Injection.—Lumbar puncture is done in the usual way, the needle entering the canal between the third and fourth lumbar vertebræ. Enough cerebrospinal fluid should be withdrawn to overcome any pressure that may be present, and also a sufficient quantity to compensate for the amount of serum to be introduced. The serum is then administered through the needle. The dose is the same as with the intraventricular injections.

Intraneural Injection.—Kuster, applying Meyer's discovery that the tetanus toxin is diffused by way of the peripheral nerves, recommends that the nerves supplying the region of the wound be exposed and the serum injected into them. The dose used is the same as given above.

Treatment of the wound of entrance is similar to that described in the prophylactic treatment, namely, chemical disinfection, or excision with the knife may be employed, according to the circumstances.

RABIES

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Rabies is an acute infectious disease caused by a virus of as yet undetermined nature, that enters the body through a poisoned wound. The disease occurs in the lower animals as well as in man, and, except for the rare accidental inoculation in laboratories, all human cases are due to a bite or some other injury inflicted by a rabid animal. In this country a dog bite is the usual method of inoculation for human beings.

The virus is found in most of the organs and secretions of rabid animals, and is especially prominent in the central nervous system and in the saliva. The parotid gland secretes the greatest quantity of virus found in the saliva. With infected dogs this secretion has been found virulent several days before the animal showed definite symptoms. All sick dogs, therefore, should be carefully isolated and observed.

The virus, entering the body through the poisoned wound, develops in the tissues at the point of inoculation, and is carried by some unknown route to the central nervous system. Here it attacks the nerve cells, produces a round-cell infiltration in the region of the ganglion cells, and apparently gives rise to certain alterations in their chromophoric granules. The latter change is not a specific one, as similar alterations have been found in these cells as a result of fatigue, exhaustion, shock, and several other conditions. The methods of rapid diagnosis of rabies, described by von Gehuchten and Nelis and by Negri, depend on finding these changes in the nervous system. Keirle [1] proves the fallacy and inutility of these methods.

The course of rabies in man differs in many ways from that of other infections. The period of incubation varies with wide limits. In Kerr and Stimpson's paper on The Prevalence of Rabies in the United States (published by U. S. Public Health and Marine Hospital Service), the average period of incubation in 70 fatal cases was sixty-two days, the shortest ten days, and the longest three hundred and eighty-two days. There are several important factors that influence the length of the period. Bites or injuries of the face and other uncovered portions of the body are followed by shorter periods of incubation and are less amenable to preventive treatment. Experimental inoculation on the surface of the brain produces the disease in about fifteen days. If, therefore, rabies manifests itself in man within this period, the virus must have been conveyed to the nervous system at the time of the biting.[2]

[1] Keirle, Studies in Rabies, Baltimore, 1909, p. 347.
[2] N. Y. Med. Jour., Feb. 23, 1907.

Further, there is a natural resistance to the virus present in the human body. This is proved by the fact that, although every known case of hydrophobia in man has proved fatal, still many of those bitten by rabid animals do not develop the disease. If no treatment is employed, 83 per cent. of those bitten by rabid animals develop hydrophobia. Here is evidence of a variation in the degree of virulence of the virus from different sources, and this may explain in part the irregular period of incubation. Paltauf [1] has been able to throw considerable light on this subject. He was able to secure autopsies on 4 persons who died of intercurrent disease during the period of preventative treatment. In all 4 cases active virus was found in the nervous system by inoculation experiments. This virus, however, was attenuated, as was shown by the fact that the inoculated rabbits developed the chronic form of rabies after a prolonged period of incubation. Paltauf also was able to obtain material from the bodies of 3 who died of other diseases shortly after completing the Pasteur treatment, and by similar inoculations with this material he was able to prove it non-infectious.

He concludes from his experiments, therefore, that when an individual is bitten by a rabid animal the virus always reaches the central nervous system. Here it meets a natural defensive mechanism, and may be destroyed or the virus may continue in the nervous system and, gradually increasing in intensity, overcome this resistance and finally cause the fully developed and fatal disease. The Pasteur treatment assists and stimulates the natural defense to such a degree that the infection is overcome and the patient recovers.

TREATMENT

The treatment of rabies is limited to prophylaxis. Every human being who develops rabies is doomed to die in spite of any method of treatment employed. "The human animal never recovers from an attack of hydrophobia." [2] This inevitably fatal outcome makes it imperative that every individual who has been exposed to possible infection with rabies should be given the Pasteur treatment. In order to be of value this treatment must be begun early, as soon as possible after the injury. The following is abstracted from Dr. Keirle's "Practical Notes on the Treatment of Those Bitten by Supposedly Rabid Animals." [3]

Efficient cauterization reduces the liability to rabies 50 per cent.; the Pasteur method fails only in $\frac{1}{3}$ of 1 per cent.; together they give the best results.

Cauterization should not be restricted to an early time limitation. The earlier it is done the better, but it is never too late, even though it be necessary to excise the indurated area of a healed wound. It has been shown by inoculation experiment that the virus was present in the scar-tissue excised from the site of the bite thirty-six days after the bite was

[1] Wien. klin. Wochenschr, 1909, xxii, 1023, and Jour. Amer. Med. Assoc., 1910, liv, 1616.
[2] Keirle, N. Y. Med. Jour., loc. cit.
[3] Studies in Rabies, Baltimore, 1910, p. 353.

inflicted. Extensive and intricate wounds should be intermittently cauterized.

The operation, as described below, is not as painful as might be imagined; an anesthetic is usually unnecessary, although the use of nitrous oxid, if it is available, seems an ideal method for avoiding shock to a delicate and sensitive person. Occasionally ether anesthesia may be required, as, for example, in cauterizing intricate wounds of the interior of the nose, the excision of scars, etc.

Efficient cauterization is not easy to do. The operation requires skill and judgment. The wounded part should be bathed in a 1 : 1000 solution of bichlorid of mercury, or in hot saturated boric solution. If near the eyes, close the lids, cover with gauze, and have assistants hold them shut. The nostrils should be treated in the same way. Inside the mouth the teeth and parts adjacent to the bites must be shut off with gauze. After the preliminary bathing the wound is dried and pure carbolic acid (phenol) is applied by means of a cotton mop, taking care that all the crevices of the wound are reached. Follow this immediately with strong nitric acid applied in the same way. A slight explosive puff takes place, after which the wound is washed with saturated solution of sodium bicarbonate and with alcohol. A dry dressing is next applied, held in place by adhesive plaster or collodion. As a rule, the wound heals under an aseptic scab and the dressings are not disturbed. If the wound suppurates, it is kept open and dressed daily.

Other means of cauterization are not so effective. The actual cautery (Paquelin or galvano-) is useful in wounds of inaccessible cavities. Silver nitrate is positively harmful and must be avoided.

As soon as possible the patient should be brought to a Pasteur institute for treatment. The technic of this method is so complex and so delicate that it cannot be carried out elsewhere. Recently in the U. S. Marine Hospital and Public Health Service they have adopted the plan of shipping the prepared virus to State health authorities, for use by them where there are laboratory facilities for its proper final emulsification and administration.

Probably the most important cases that come to the doctor for his decision are those in which an individual has been bitten by an animal not definitely rabid. Two points must be settled—what to do with the animal and what to do for the man. If the animal can be kept so that it cannot escape and cannot do harm, it should be kept under observation for fourteen days, preferably in its usual surroundings, if they are good; and if this cannot be done, it should be put in charge of a veterinarian or some association caring for animals.

During this time the man should have the Pasteur treatment. If, at the end of fourteen days, the animal is well, stop the treatment and tell the patient that the animal was not rabid when the biting took place, and that there is no danger of hydrophobia. If, on the other hand, the animal proves rabid, the fourteen days preventive treatment may be the salvation of the patient, because the inoculations are of no

value if the disease develops during the fifteen days of treatment required.

If the animal has escaped, those bitten must be treated just the same. This is also necessary if the animal has been killed. If the animal is about to escape, it should be killed for the protection of the public. All the early methods of examination of the animal are defective, because they may be negative and yet the animal have rabies. Even the animal inoculations may prove fallacious, because the virus is extremely sensitive to a number of external conditions, and some flaw in technic may be responsible for the negative result.

The disease is so terrible in its absolute fatalness and intense suffering that every one who has been exposed to any possible chance of infection should be given the benefit of the Pasteur treatment. The twenty days required for the treatment, the expense, etc., pale into the greatest insignificance compared with the certainty of escape from this hideous disease.

ANTHRAX

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Local infections from anthrax bacillus are rare in this country. The clinical appearance of the affection cannot always be differentiated from one produced by some other microörganisms, especially the streptococcus. The morphology of the anthrax bacillus is so characteristic that the diagnosis, as a rule, can be made at once by the examination of cover-slip preparations from the discharge of the wound. The possibility of anthrax infection should be constantly borne in mind, and every local infection having a clinical appearance like malignant pustule should be examined bacteriologically before treatment is instituted. When the anthrax bacillus is found in the local infection, blood-cultures should be made at once. It is only from cases in which we have such a careful bacteriologic study that we are able to formulate conclusions in regard to the proper treatment.

TREATMENT

The most important progress in recent years is the introduction of the serum treatment for both local and general anthrax infection. Previous to this we find in the literature the discussion of the following methods of treatment: (1) The expectant; (2) the antibacterial, in which the infection is combated with local injections of carbolic acid and bichlorid of mercury; (3) the complete excision of the local infection.

The Expectant Treatment.—This method of treatment is based on the fact that man is not highly susceptible to the anthrax bacillus and that clinical observations have indicated that manipulations of the local infection are apt to be followed by death from general infection. Bacteriologic investigations have demonstrated that anthrax is fatal in man only when the bacilli get into the general circulation. Rammstedt [1] reports a case which demonstrated that even the most grave local infection may result in recovery without operative interference. The local infection consisted of an area of gangrene about the size of a "quarter" on the lower surface of the tongue; the entire tongue was edematous and protruded from the mouth: the mucous membrane of the mouth and tissues beneath the neck were edematous; there was evidence of consolidation of the lower lobe of the right lung. In the gangrenous area the anthrax bacilli were found: the sputa contained many pyogenic organisms, but no anthrax bacilli; the blood was sterile. The infection then was a distinctly local one. The treatment consisted

[1] Münchener med. Wochenschrift, 1899, No. 19; Review, Centralblatt f. Chir., 1899, p. 926.

of applications of ice, mild mouth irrigations, and morphin hypodermically. The gangrenous area sloughed without further extension, recovery and complete healing took place in three weeks. In the recent literature I can find no case in which the clinical manifestation of the local infection was worse than in this one of Rammstedt, which recovered without any special treatment. This case of Rammstedt had the extensive edema around the local infection, which is usually considered a very grave diagnostic sign. Justi,[1] from an observation of 13 cases of anthrax treated in Hamburg between the years 1885 and 1899, comes to the conclusion that at least in certain cases this expectant treatment of Rammstedt is to be preferred. There were 5 deaths among his 13 cases. In these fatal cases the primary infection was on the side of the neck, associated with marked edema. In 3 in which energetic surgical treatment was instituted it appeared that the operative intervention increased the gravity of the disease. The autopsy in all these 5 fatal cases demonstrated a general infection with the anthrax bacillus. He does not note, however, whether or not the anthrax bacillus was found in the blood previous to the operative interference. Without such an observation one cannot consider that his conclusions are of particular value. In the 8 cases which recovered the local infection was on the forearm, the cheek, forehead, back of the head, and back of the neck. Unfortunately, in these cases the review does not mention any blood examination. It is interesting to note that all of Justi's patients were laborers who handled American hides; their arms were usually bare, and in transporting the hides the package rested upon the back of the head and neck.

Müller,[2] in 1895, writing from the same clinic as Rammstedt, was one of the first to advocate this conservative treatment, believing that it was a protection against general infection. On the other hand, Völkers[3] reports a fatal case after this conservative treatment. The local infection was on the lower right eyelid. When admitted on the sixth day, there was extensive edema of the face, neck, and mucous membrane of the mouth and pharynx. Völkers mentions the fact that E. Fränkel has demonstrated that in this extensive edema the lymphatics are filled with the anthrax bacillus, and any attempt at excision when this is present increased the danger of general infection. I cannot believe that the edema so often present around the malignant pustule can always be explained as Fränkel states. Clinically, it is true that the onset of very extensive and marked edema is usually associated with general infection, but in many cases this edema so rapidly disappears as the local infection recedes that one could hardly believe that the lymphatics were filled with the anthrax bacillus. Unfortunately, I can find no bacteriologic proof. However, in other infections, especially streptococcus, this extensive local edema around the area of infection is frequently observed, and in my own experience the edematous tissues are frequently sterile.

[1] Review, Centralblatt f. Chir., 1899, p. 729. [2] Centralblatt f. Chir., 1895, p. 11.
[3] Münchener med. Wochenschrift, 1898, No. 20.

The Treatment of Anthrax by Injections of Carbolic Acid.—Strubell,[1] writing from the clinic in Jena, is the chief advocate of this treatment. It consists of a local hypodermic injection (10 to 15 min.) of a 3 per cent. solution of carbolic acid. These solutions are given frequently thirty times a day and as many as 400 such injections have been given. The injections are made around the area of infection. Combined with this the infected area is covered with hot poultices up to 63° C. He reports 2 cases; both recovered. One appears to have been very grave; the local infection confined to the nose was of six days' duration; it was surrounded with marked edema. The lymphatics of the neck were swollen. The anthrax bacillus was found in the gangrenous focus, but not in the blood. Strubell states that if an operation had been performed it would have been necessary to completely excise the nose. The carbolic acid treatment was begun at once and continued for eighteen days. After the separation of a small area of gangrene the local infection healed and the swelling of the glands disappeared. The probabilities are that in this case the anthrax bacillus was not present in the swollen glands. Sinclair [2] reports such a case. The local infection on the inner side of the thigh followed a slight injury from a splinter of wood soiled with bone-manure. The glands in the groin were involved. The area of local infection was excised and the inguinal gland removed. The anthrax bacilli were found only in the central part of the local infection associated with streptococci. In the swollen lymph-glands no anthrax bacilli could be demonstrated.

The carbolic acid treatment as described by Strubell, on the whole, seems popular. I find successful a case recorded by Voigt.[3] The pustule was on the nose and associated with extensive edema of the face and neck. It was considered too extensive for operation. Recovery took place after 300 injections of carbolic acid without symptoms of any toxic effect.

Local injections of pure carbolic acid have also been used with success and without bad results. Fisher [4] reports a recovery in a very grave case. The local infection was on the forearm, of eight days' duration, and associated with marked edema. The first injection of carbolic acid was of 1 dram of a 10 per cent. solution; the next day 1 dram of pure carbolic acid was injected into, around, and beneath the pustule; daily injections of pure carbolic acid were continued for four days. Fisher refers to Jarnorski, who has reported 72 cases, all of which have recovered after carbolic acid treatment. Dabney [5] reports a case of anthrax of the lower lip cured by injections with pure carbolic acid. Mutschler [6] reported favorably before the Philadelphia Academy of Surgery on the treatment of anthrax by the injection of carbolic acid.

[1] Münchener med. Wochenschrift, 1898, No. 48, and 1900, No. 19; Review, Centralblatt f. Chir., 1899, p. 432, and 1900, p. 701.
[2] British Medical Journal, March 31, 1900.
[3] Jahresbericht f. Chir., 1898, vol. iv, p. 127.
[4] Therapeutic Gazette, August, 1900.
[5] Philadelphia Medical Journal, September 29, 1900, p. 574.
[6] Journal of the American Medical Association, June 26, 1901, p. 1083.

Other observers, Caforio [1] and Corseri,[2] advocate similar injections with 1 per cent. solution of corrosive sublimate. Caforio reports 18 cases, in some of which the infection was very grave, associated with edema and general symptoms. Cipriani [3] advocates the injection of 1 per cent. solution of chinosol. His experience with carbolic acid and nitrate of silver solutions indicated danger of intoxication from these drugs. Aujesky [4] has demonstrated experimentally in animals that injections of spleen emulsion produced immunity in 75 per cent. of animals; but when the emulsion was injected after infection of the anthrax bacillus there were only 25 per cent. of recovery. Similar to the injection of brain emulsion in tetanus, spleen emulsion in anthrax can hardly be recommended.

Operative Treatment.—Many authorities recommend the complete excision of the anthrax pustules, followed by the disinfection of the open wound with strong antiseptics (pure carbolic acid) or the Paquelin cautery. Sinclair's successful case has already been described. Bousfield [5] reports excision of a pustule over the sternocleidomastoid muscle, with recovery. Clark,[6] a pustule on the forehead successfully excised. In this case there is, however, no bacteriologic report. Recently Dr. McGlannan successfully treated a case of anthrax, occurring on the forearm of a man who was a wool puller, by excision of the pustule and a surrounding area of healthy tissue. The wound was disinfected with pure carbolic acid and alcohol and dressed with wet bichlorid compresses. The organism was demonstrated in smears from the pustule and in fixed sections from the tissue removed.

The good results in these various methods speak favorably for the prognosis of anthrax in man. On the whole, I should recommend the complete excision of the pustule, if possible, and the disinfection of the open wound by pure carbolic acid. However, in view of the results after the conservative treatment or after the injection of carbolic acid one would hesitate to perform a mutilating operation. In such an event I should recommend the injections of pure carbolic acid; if properly performed it is distinctly a stronger antiseptic, and experience with carbolic acid has clearly demonstrated that there is less danger of poisoning when the pure acid is used than when solutions are employed. The very hot poultices recommended by Strubell should be used, whether excision is practised or not.

The Treatment of Anthrax by Serum Injections.—The question whether the anthrax bacillus produces a toxin is not yet settled, but we know that attenuated cultures serve as vaccine to animals susceptible to anthrax (Welch). Conradi,[7] from his investigations, claims that there is no proof that the anthrax bacillus produces a toxin, but

[1] Revista medica della R. Marina, 1899, Fasc. 3.
[2] Lo Sperimentale, 1899, No. 1.
[3] Allgem. Med. Central-Zeitung, 1898, No. 7.
[4] Centralblatt f. Chirurgie, 1899, p. 39.
[5] Lancet, October 20, 1900.
[6] Ibid., November 10, 1900.
[7] Zeitschrift f. Hyg. und Infectionskrankheiten, Band xxxi; Review, Centralblatt f. Chir., 1899, p. 932.

it is the pure type of an infectious microörganism. If this is true there can be no anthrax antitoxin. Van Hook [1] writes: "It is to be hoped that an antitoxin serum will soon be provided for this disease, as has been experimentally attempted by Emmerich." Sclavo [2] claims that from his own and experiments of others he has obtained an "anti-carbuncle" serum from immunized animals. He states that when this serum is used there is no necessity for local treatment. The edema rapidly recedes, the necrosis of the tissues is always very limited, a scab forms, and after separation leaves but very little scar. The serum is injected subcutaneously in the abdominal wall. He uses 20 to 30 ccm. for adults, and the injection is repeated in about eight hours. Following the serum injection there may be an increase of temperature, which soon falls, but there is always a rapid improvement in the local and general condition of the patient. Later Sclavo [3] states that 100 cases have already been treated with this serum, with only 2 deaths. Some of his own cases were very grave infections, and he found that in such instances the serum should be injected intravenously. Asternio [4] reports 3 cases of anthrax pustule cured with the anticarbuncle serum of Sclavo. In 2 patients the infection was on the face, and the general condition bad. In the third patient the carbuncle was on the forearm, with great edema of the extremity and the body. The patient seemed beyond hope of recovery. Injections of 12 ccm. of the serum were given. One patient received one injection, 2 patients two injections each. The recovery was rapid. A rise of temperature after the injection, which quickly receded, was noted. Dasso [5] claims that the anti-anthrax serum prepared by Mendez is more powerful than Sclavo's or Sobernheim's. He reports 130 cases treated with this serum (dose 10 ccm. injected subcutaneously); there were 9 deaths, all but 2 from secondary infections. I can find no reference to Mendez's serum. Sobernheim has made a number of communications on active and passive anthrax immunity.[6] I can find no case reported in the literature treated by serum in which recovery followed when the anthrax bacillus was present in the blood, but as I have been unable as yet to get all the original articles, I am not prepared to make a positive statement on this fact. Compared with other statistics, Sclavo's 100 cases, with 2 deaths, and Dasso's 130 cases, with 9 deaths, if they are authenticated by bacteriologic reports, should certainly be considered a great advance in the treatment of anthrax. I can find no report of the use of an anti-anthrax serum in this country.

[1] Text-book of Surgery, Warren and Gould, 1900, vol. i, p. 195.
[2] Revista d'Igiene e San. Publ., 1898, Nos. 22 and 23; Review Centralblatt f. Chir., 1900, p. 64.
[3] Lo Sperimentale, 1899, No. 4; Review, Centralblatt f. Chir., 1900, p. 384.
[4] Gaz. med. di Torinó, 1900; Review, Centralblatt f. Chir., 1900, p. 417.
[5] Anales Bel. Circ. Med. Arg., Buenos Ayres, December, 1900; reviewed in Journal of the American Medical Association, March 2, 1901, p. 607.
[6] Berliner klin. Wochenschrift, 1899, No. 13.

GLANDERS

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Glanders is a specific contagious disease, occurring naturally in the Æquidæ, but transmissible to man and other animals.

The bacillus mallei, the organism causing glanders, is found in the secretion of animals suffering from the disease. Practically all human cases occur in persons who work with horses. The bacillus may enter the body through the unbroken skin or mucous membrane, although, as a rule, infection starts in a wound or abrasion.

The disease is called glanders when the lesions occur in the respiratory tract and its appendages; farcy, when the skin and its lymphatics are the only organs involved. Acute and chronic forms are described. In the former, the disease runs the course of an acute pyemia with multiple abscesses, from the pus of which the specific organism, bacillus mallei, may be obtained. Lung complications are frequent, and these cases, as a rule, terminate fatally in from two to three weeks.

The chronic form is characterized by granulation tissue, swellings occurring in the subcutaneous tissue or under the exposed mucous membranes. The epithelial covering of the granuloma soon ulcerates, and then has an appearance like that of an ulcerated gumma. Metastatic abscesses are rare. This form of the disease persists for a very long time, and the prognosis for recovery is good, provided acute glanders does not develop.

TREATMENT

In the treatment of the chronic form the most important point is to avoid setting up an attack of acute glanders. Therefore, the ulcers should never be cureted or rubbed with antiseptics. If technically possible, the entire infected area and the next group of lymphatics should be excised. Abscesses are incised and drained if they cannot be completely excised. The wound should be disinfected with pure phenol, followed by alcohol, or iodin, and left open and dressed with wet bichlorid gauze.

The general resistance of the patient must be increased as far as possible with good food, especially milk and eggs, given in abundance, and by life in the open air. Salt solution subcutaneously or per rectum, given freely at the onset of the disease and whenever the heart seems to require stimulation, is of great benefit. Occasionally digitalin or strophanthin will be required to aid the flagging heart.

The acute form is usually fatal in spite of any form of treatment. If a point of inoculation is known or suspected, it should be excised or

incised, and the wound cauterized and left open. Abscesses must be drained and accessible nodules excised. All methods of keeping up or increasing the patient's resistance are to be employed. Salt solution, subcutaneously and by rectum, should be given in large quantities. The nutrient enema, mentioned in the treatment of tetanus, is a valuable means for keeping up nutrition.

Mallein.—Silkman, a veterinarian,[1] from his experience in treating horses, concludes that the use of small and repeated injections of a specially prepared mallein at the beginning of the disease in man would convert the acute into the chronic form, and consequently give greater possibility of ultimate recovery.

Leys [2] denies any curative effect from the use of mallein, and states that this agent is of value only in the diagnosis of the disease in horses.

Meyer [3] suggests the injection of bullocks' serum, because horned animals have a natural immunity to glanders.

[1] Medical Record, October 5, 1907.
[2] American Practice of Surgery, vol. ii, p. 47.
[3] Jour. Amer. Med. Assoc., vol. l, p. 1593.

ACTINOMYCOSIS

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Actinomycosis is an infectious disease caused by the ray fungus (Trichomyces actinomyces). The fungus gains access to the body through different avenues—abrasions of the skin and exposed mucous membranes, carious teeth, etc. In some cases the disease is limited to the intestines and in other cases to the lungs, so that the organisms must be able to enter the body with food and air.

The inflammatory reaction at the point of infection gives rise to a mass of granulation tissue having a fibrous outer zone surrounding a cellular inner one, which usually includes a necrotic center. Occasionally the disease heals spontaneously, the granulation tissue ending in a mass of fibrous scar-tissue that may become calcified. As a rule, however, the disease extends by permeation of surrounding tissues until the mass reaches the surface of the body, or one of its cavities, and there ruptures the normal covering of the part, forming a sinus or fistula.

For the most part, the diagnosis is not made until this stage is reached and the discharge from the sinus is examined. Then the pathognomonic sulphur yellow granules in the pus are easily detected.

The organism has great resistance and its destruction in the tissue is very difficult. The process remains a local one for a long time, steadily progressing, however, to a fatal termination in exhaustion. When the growth involves a vein in the primary focus, metastases may occur in any part of the body. Local recurrence after excision of the masses is frequent. The greatest danger in the disease is that of secondary infection of the sinuses by the pyogenic bacteria. Such an accident usually results in a rapidly developing pyemia or septicemia.

The treatment of an accessible focus is by complete excision. If this can be done before sinuses have formed, and if the excision takes in a good margin of uninvolved tissue, the prognosis is very favorable. On the other hand, if sinuses have developed, they should be well disinfected with pure carbolic acid (phenol) and alcohol, followed by iodin, before operating.

Partial Excision.—When complete excision is technically impossible, a partial excision should be done, removing as much of the diseased tissue as possible and cauterizing the exposed surface with the Paquelin cautery. The wound should be left open and packed with iodin or iodoform gauze. A partial excision must always be accompanied by systematic general treatment, best by the internal administra-

tion of the iodids. As the course of the disease is usually very chronic, the drug treatment must be carried out through several years.

Iodin Locally.—Tincture of iodin injected into the sinuses and iodoform in powder or gauze used in the open wounds are the methods of applying this drug. Potassium iodid, in 10 per cent. solution, is often used locally.

Iodids Internally.—The potassium or sodium drug should be given in increasing doses, up to 60 gr. a day. For a number of years many clinicians have reported favorable results from the use of this remedy. Maier [1] got the best results from giving sodium iodid in three-day intervals, as follows: 15 gr. the first day, 30 the second, and 45 the third; none for three days again, and then repeating the same progression.

Copper sulphate, locally and internally, is recommended by Bevan of Chicago. This drug is given in $\frac{1}{4}$-gr. pills, three times a day, while a 1 per cent. solution is used locally by irrigation.

Tuberculin.—The use of old tuberculin has given good results in certain cases of inoperable actinomycosis, especially of the abdominal type. The tuberculin is given hypodermically in such doses as will bring about a distinct local reaction without a great general one. The patient acquires a resistance to the remedy, so that very large doses (6 grams in 1 case) are used toward the end of the treatment.

Whatever other form of treatment is used, the internal administration of the iodids should be included. Maier (loc. cit.) gives statistics, based on a study of 300 cases, to show that this is the most reliable means of treatment at our disposal.

MADURA FOOT

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

This name is given to a disease caused by infection with the fungus Streptothrix maduræ, or Actinomyces maduræ, an organism resembling in many ways the actinomyces fungus.

The disease manifests itself as an inflammatory swelling, usually of the sole of the foot. This soon breaks down and forms sinuses. These sinuses usually pass through a succession of repeated spontaneous healings and openings. In its course the disease gradually involves deeper structures, until finally the bone is destroyed.

If seen early enough, a circumscribed area should be excised and the resulting wound disinfected. If there is extensive involvement of soft parts, or if the bone is diseased, amputation becomes necessary.

The wearing of shoes or sandals gives certain prophylaxis.

[1] Beitrage zur Klin. Chirurg., lxiii, p. 472.

FOOT-AND-MOUTH DISEASE

By Joseph C. Bloodgood, M. D., and Alexius McGlannan, M. D.

Foot-and-mouth disease or aphtha epizoötica is a contagious febrile disease, very common among animals and often communicated to man. The disease is self-limited and is characterized by a vesicular eruption that occurs on the buccal mucous membrane, the lips, and the skin of the digits.

The treatment consists in the use of febrifuges and the prevention of secondary infection of the epithelial lesions. The latter is best accomplished by the use of an antiseptic mouth-wash, such as Dobell's solution, or a solution of boric acid, and the use of bismuth and boric acid, or boric talcum as a dry powder for the other lesions.

PERTUSSIS

By Samuel McC. Hamill, M. D.

Pertussis is an acute infectious disease of unknown bacteriology. Since Poulet, in 1867, described a bacterium termo, which he considered the causative factor, a number of protozoa and various bacteria have been isolated from the sputum, the mucous surfaces of the trachea and bronchi, and the foci of bronchopneumonia, and each discoverer has been convinced that his results explained the origin of the disease.

The first important finding was that of Afanassjew (1887), who isolated from the expectorated mucus and from the foci of bronchopneumonia in patients dying from this complication a short motile organism, which appeared either singly, in pairs, or short chains, which he called the Bacillus tussis convulsivæ. The diplococcus of Ritter (1892) and the bacillus of Czaplewski and Hensel and Koplik, both isolated as the result of careful bacteriologic work, have been accorded an etiologic relationship by their discoverers as well as by several later investigators (Walsh, Reyher, von Zusch, Cavasse).

In 1891 Jochmann and Krause discovered a bacillus in the mucous secretions of the upper air-passages. It also resembled the influenza bacillus, but, unlike previously described varieties, it grew exclusively upon hemoglobin containing media.

Two years later Arnheim described a similar bacillus, and in the same year Jochmann and Moltrich reported upon the bacillus discovered by Jochmann and Krause in 1891. They found it in the sputa and foci of pneumonia in 20 cases dying from this complication. They considered it the causal factor in these cases, but made the very likely suggestion that "it is improbable that the typical paroxysmal cough of pertussis is produced by any one fixed bacillus."

In 25 of 26 cases of pertussis examined by Martha Wollstein, a bacillus similar to that described by Jochmann and Krause was isolated. Agglutination tests with the blood of patients, as well as of immunized rabbits, served to differentiate it from the influenza bacillus. The blood of the pertussis cases agglutinated the pertussis bacilli, isolated from the sputum in dilutions of 1 : 200. After the second week of the disease the influenza bacillus reacted with the blood of such patients in dilutions of 1:20. Rabbits immunized with the pertussis bacillus, whose blood-serum reacted with that organism in dilutions of 1:500, agglutinated the influenza bacillus in 1:200.

In 1906, Bordet and Gengou[1] described a small cocco-bacillus which, in specimens prepared directly from the sputum, "was usually rather longer and plumper" than the influenza bacillus, although quite comparable to the latter in its morphology. It was most easily found at the stage at which "the cough became typical."

Agglutination tests were positive with the blood of infected children.

This organism has been studied by various other observers, whose opinions differ regarding it. Soulima,[2] on the basis of its morphology and staining characteristics, considered it identical with the Bacillus Eppendorf.

Reyher[3] believes it the same organism which he described in 1903, but as he produced no serum reactions in support of the specificity of his organism, Bordet and Gengou have ignored his criticism.

Klimenko,[4] in 1908, found this organism in the heart and lungs of a child dying in the third week of the disease, and by injecting pure cultures into monkeys and young dogs produced in them "a barking cough" which he thought was an indication of pertussis.[5]

Wollstein[6] thinks it likely that the cough was due to distemper, since she had observed distemper follow her experiments upon animals with this organism.

Wollstein found the Bordet-Gengou bacillus constant in the early stages of pertussis, but she found the influenza bacillus at the same time, and the agglutinins were neither more regular nor higher for the former than for the latter. The two organisms she found culturally distinct and of different action upon laboratory animals. She concludes, therefore, that the Bordet-Gengou bacillus may be considered a *possible* cause of pertussis.

Fränkel[7] found the organism in a relatively small number of the cases he examined. His agglutination tests were inconstant in their results and positive compliment deviation was observed but once. He also found the same organism in 2 cases suspected of tuberculosis and not having pertussis.

Bacus and Seiffert[8] have confirmed the findings of Bordet and Gengou and their followers as to the identity of their bacillus, but they do not admit that their results prove the organism the cause of pertussis.

Quite recently Savini and Savini-Castano[9] have studied the experimental biology of the Z. bacillus (Manicatide) and its relation to pertussis.

Manicatide first described it as the cause of pertussis in 1895. It also is described as a cocco-bacillus and morphologically is evidently quite close to the influenza group. They speak of the "beautiful

[1] Bordet and Gengou, Ann. de l'institut Pasteur, 1906, Tome xx, p. 731.
[2] Soulima, Soc. de biol. de Paris, 1907, vol. lxiii, p. 11.
[3] Reyher, Ann. de l'institut Pasteur, 1907, vol. xxi, p. 727.
[4] Klimenko, Central. f. Bakt. orig., 1908, vol. xlvi, p. 218.
[5] Ibid., vol. xlviii, p. 64.
[6] Wollstein, Jour. Exp. Med., 1909, vol. iv, p. 41.
[7] Fränkel, Münch. med. Woch., 1908, vol. lv, p. 1683.
[8] Bacus and Seiffert, Münch. med. Woch., 1909, No. 3, p. 130.
[9] Savini-Castano, Central. f. Bakt., 1909, p. 582.

results" obtained in the treatment of pertussis by a serum prepared from this organism.

It is a matter of interest that there is a rather striking morphologic similarity to the influenza bacillus in all of the different organisms that have been described as etiologically related to this disease. Whether this is a matter of any significance is difficult to determine, but it is not unlikely that anyone of these several bacteria may be capable of producing the disease.

The evolution of the microörganism in the pertussis patient results in a catarrh of the upper air-passages, involving mainly the mucous surfaces below the epiglottis. Beyond this the recorded lesions relate almost exclusively to the complications. This catarrhal condition, which may be very mild even in severe cases, is not sufficient of itself to account for the cough, which is the most striking manifestation of the disease. Therefore we must look for some additional factor. Researches have failed to yield a satisfactory explanation, but it is not unlikely that the toxic products of the infecting organism, by their action upon the nervous system or special nerve tracts, produce a degree of excitability of the terminal filaments of the vagus, which render them especially responsive to the mucous secretions which are always present at the time of the paroxysm. The other symptoms are also mainly attributable to the products of infection.

Pertussis occurs epidemically throughout the world, and in all large cities it is doubtless endemic. It may prevail at any time in the year, but the outbreaks are most common and most severe in the late winter and early spring.

It is almost exclusively a disease of early life, adults rarely being affected. The weak and the strong are alike its victims, and it is more prone than any other infection to attack children in the early months of life. Second attacks are uncommon. It is highly contagious and almost always transmitted by direct and close contact, and probably from direct inhalation of the breath or particles of coughed up sputa.

Ordinarily it consists of three stages: (1) the catarrhal stage of eight to ten days' duration; (2) the paroxysmal stage, which lasts from three to four weeks; and (3) the stage of defervescence, which usually ends from eight to ten weeks after the onset of the disease. In uncomplicated cases the manifestations of the first stage are those of any catarrh of the upper air-passages: coryza, mild fever, cough, which shows a gradual increase with a tendency to become paroxysmal, to be worse at night, and after a few days to be accompanied by vomiting. Those of the second stage are mainly nervous, chief among which are the characteristic cough, general nervous irritability, and frequent vomiting. The third stage is marked by a gradual decline in all the symptoms.

The principal complications are bronchitis, broncho- and occasionally croupous pneumonia, and emphysema on the part of the pulmonary system, convulsions (general or localized), spasm of the glottis, various paralyses, sudden total blindness, deafness, aphasia, etc., on the part

of the nervous system, and hemorrhages (especially epistaxis), and dilatation of the heart on the part of the cardiovascular system.

The attack of pertussis favors infection by the tubercle bacillus and invariably stirs up a latent tuberculosis. The mortality in children under three years of age is high, reaching its maximum during the first year. Death is usually the result of some one of the many complications, bronchopneumonia and convulsions contributing most largely. It is well to bear in mind that sudden death may occur in seemingly uncomplicated cases as the result of spasm of the glottis or heart failure. In severe cases with frequent paroxysms associated with vomiting the nutrition may become so impaired as to produce a fatal termination.

Pertussis tends to spontaneous recovery and has no specific treatment. As indicated by the above, the main objects of treatment are protection of the public (prophylaxis), control of the disturbing symptoms, cough, vomiting, constipation, and insomnia, prevention and treatment of the complications, and careful direction of the convalescence.

TREATMENT

Being an infectious disease, attention must first be given to **prophylaxis.** It is unnecessary to attempt the protection of adults. The disease is most contagious in the catarrhal stage. It is well nigh impossible to protect the children of the same household, as infection has usually occurred before the nature of the disease has been determined. It is advisable, however, to make the attempt, especially if the isolation can be accomplished early and the well children sent to an uninfected house, where they will not expose others. During the prevalence of epidemics, parents should be instructed to isolate all children immediately upon the occurrence of symptoms of coryza, and to keep children under three or four years of age and all delicate children by themselves, as the disease is much more serious in them. Isolation should be continued until the paroxysmal cough has ceased, although the danger of contagion is probably not very great during the stage of decline.

Griffiths quotes Comby as saying that infants accidentally received into the pertussis wards in L'Opital des Enfants, where the cases are all in the second stage of the disease, rarely become infected, but that cases in the catarrhal stage of pertussis admitted to the general wards invariably transmit the disease to the other children. He also refers to Weill's experience in the Charity Hospital in Lyon in admitting 29 cases in the advanced stages to the common wards, exposing 338 infants without transmitting the disease to any of them.

This disease is sometimes transmitted indirectly through the medium of contaminated clothing and by attendants and physicians going directly from infected quarters to other children.

The accumulating evidence as to the probability of non-susceptible individuals acting as carriers of infection through the medium of the mucous membranes of the upper air-passages (diphtheria, meningitis, etc.) would strongly suggest the likelihood of conveying the infecting

organisms of this disease, which attacks the upper air-passages, in such a manner. Therefore, it becomes the duty of the attendants in cases of pertussis to avoid contact with well children, and of the physician, in addition to protecting his clothing by wearing a gown and thoroughly scrubbing his hands at the end of his visit, to protect the mucous membranes of the upper air-passages by wearing a mask, similar to that employed by surgeons during operations, when in close contact with the pertussis patient.

The soiled clothing of patients should be soaked in antiseptic solutions or washed apart from those of other children. Where uninfected children are retained in the household, the precautions should be the same as those employed in any of the infectious diseases. (See Part I.)

Cats and, more especially, dogs are susceptible to pertussis and capable of transmitting it. Sticker quotes Jahn as having seen it transmitted to a child by a dog ill with the disease, and Peter Lehnen (1872) reported the case of a dog of three years infected by a child. Schmelz (1867) wrote a detailed account of an attack in a dog, which, as Sticker points out, left no question as to the accuracy of the diagnosis. Melhose (1836) noted, in an epidemic he observed, that the dogs which were exposed were nearly always infected and Jahn observed the disease in cats as well as dogs.

An instance has been brought to the writer's attention in which a kitten suffering from a severe paroxysmal cough, violent sneezing, and attacks of vomiting, from which it died, transmitted to a child who fondled and kissed it a severe cough having all the manifestations of pertussis.

It is important, therefore, to keep the dogs and cats of a household from coming in contact with the patient and, more especially, of forbidding children to play with coughing dogs and cats, especially during whooping-cough epidemics.

In controlling the respiratory catarrh and the toxemia, with all their manifestations and the effect of the parasite upon the individual, so much is accomplished by good hygiene that it seems fitting to consider the hygienic treatment separately.

Hygienic Treatment.—*The Apartments.*—During the catarrhal stage the patient should be confined to bed if feverish. In any event, he should be kept indoors and protected from extremes of or sudden changes in temperature. When available, two well-ventilated rooms should be set aside for his use, one to be used by day and the other by night. It is the very reasonable practice of some pediatrists to fumigate each room once in the twenty-four hours by filling with the vapor of formalin for one hour (Koplik) or by a more prolonged exposure to the fumes of burning sulphur (Comby, Monti, Mohn). Holt fumigates "occasionally" and has had "decided benefit from the daily use in the room of one of the small formalin lamps." The object of these measures is to prevent reinfection. During seasonable weather, after the catarrhal stage is ended and when the patient is out of doors and the rooms are not much occupied, thorough cleansing and airing are sufficient, provided the bed clothes and body garments are changed each

day. The temperature in the sleeping room should be between 60° and 68° F., and during the day hours between 65° and 70° F. Where only one room is available for the constant use of the patient, he should be removed to an adjoining room of equal temperature for several hours each day to admit of cleansing and thorough airing of the permanent apartment. Infants and very delicate children should be confined to the house throughout the attack, especially in the autumn, winter, and spring months, but should not be deprived of a constant interchange of air through the medium of properly protected open windows. In moderate weather a daily exposure to fresh air may be accomplished by placing the patients close to the open windows, having previously clothed them in their outing garments. Among the poorer classes, where refinements are not possible, it is wiser to advise the placing of all cases in the open air well protected than to retain them in their usual close and overcrowded quarters.

Bathing.—The entire body should be sponged once each day with tepid water. The older and robust children should receive a daily tub bath.

Clothing.—Night and day light woolen garments should be worn next to the skin, and when the child is going out the top clothing should be regulated to meet the variations in the external temperature.

Diet.—During the catarrhal stage the diet should consist of easily digested soft foods, of which milk should be the chief. Throughout the attack it should receive careful attention. Infants on modified foods often require a reduction in the strength of the formula. Where vomiting is frequent, small feedings immediately following the attack are often necessary. Good can be accomplished, as suggested by Holt, by administering predigested foods at these times. In older children and in those with mild attacks the diet may be more liberal, but it should always be easy of digestion. Flesh should not be given more than once each day and preferably with the midday meal.

Exercise need be restricted only in so far as is necessary to prevent overheating, detrimental action upon the overtaxed heart, and increase in the number of paroxysms.

Rest.—As the paroxysms are more frequent by night than day, rest may be disturbed. Toxic insomnia may also exist. To make up for the loss of sleep thus entailed, children should be induced to sleep during a portion of each day. Any recurrence of fever or evidence of complications should send the patient to bed.

After the paroxysmal stage is well advanced, change of climate, especially to warm dry climates and the seashore (in the warm seasons), is most helpful. Unfortunately this is difficult to accomplish because traveling involves the exposure of other children. To overcome this danger, Variot has suggested for Europe that railroad companies reserve special compartments to be occupied by pertussis sick children, bearing proper certificates from their attending physicians.

In the presence of extensive epidemics arrangements of a similar nature might be made with our own railroads, provided that at the same

time satisfactory quarters at the resort selected be obtained for the proper housing and control of such cases, a sort of temporary sanitorium.

Medicinal Treatment.—This may be conveniently divided into local and internal.

Local Treatment.—Remedies thus used are administered as insufflations, inhalations, and local applications to the upper throat and larynx. Insufflations are not practicable, because their use is alarming to the patient and, therefore, liable to produce paroxysms. The attempts of Moncorva, Hagenbach, and others to apply substances locally have met with little success. Much more can be gained by the use of medicated vapors or steam inhalations. The remedies ordinarily used in this way are creosote, compound tincture of benzoin, cresolin, and carbolic acid. They act by thinning the secretions and perhaps to some extent as antiseptics. In the writer's experience the most satisfactory results have been obtained by the use of menthol and the compound tincture of benzoin and creosote in the croup kettle recommended by Holt; 15 gr. of menthol with 1 or 2 dr. of the compound tincture of benzoin are placed in the croup kettle half-filled with hot water. The patient, with the eyes bandaged, is placed within a few feet of the end of the spout and the vaporization is continued for an hour or more. In the early hours of the night this procedure is repeated and continued for a longer period. This usually reduces the number of paroxysms and in mild cases will be the only remedy required.

Vaporizations with creosote are used alternately with the above. The drug is placed on the sponge in the neck of the spout and the vapor directed into a tent made by throwing a sheet over the top of the infant's crib or, in the case of older children, by draping a sheet over the backs of two chairs.

Cresolin is a less effective remedy used in the same manner. The author has had no experience with carbolic acid. Any of these remedies can be used in the ordinary cresolin lamp and, among the poorer patients treated in an ambulating service, it has the advantage of being cheaper, the primary cost and the amount of alcohol used being less. All of these measures are more satisfactorily employed during the early hours of the night, as this does not interfere with the patients' outing.

Internal Administration of Drugs.—The remedies which have best stood the test of time are antipyrin, belladonna, and quinin. After an extensive experience with each of them, I have come to rely mainly upon antipyrin. It can be administered in relatively large doses and should be begun early in the attack. To a child of six months $\frac{1}{2}$ to $\frac{3}{4}$ gr. may be given every third hour; to a child of one year, 1 gr.; and from two to five years, from 2 to 3 gr. It is best given with 15 or 20 min. of whisky, which serves to dissolve the drug and to counteract its depressing effect. Where it is desired to thin the viscid secretions, ammonium chlorid in doses of from 1 to 5 gr. may be added to the antipyrin mixture.

If any advantage is to be obtained from the use of belladonna, it

must be given in the manner indicated by Jacobi, namely, up to its physiologic limit. To use his own words: "It must be given in a dose sufficient to produce erythema or at least a flushed condition of the face and, as it were, feverish appearance after every dose." The drug is administered in increasing doses until these effects are noticed. To infants of six months he gives $\frac{1}{6}$ gr. of the alcoholic extract three times daily and to children of three or four years $\frac{1}{2}$ gr. three times daily. The tincture is a more convenient preparation, since it is quite as effective and admits of more ready variation of the dose; 1 min. may be given three times daily to an infant of six months, to be gradually increased until the dose required to produce the above symptoms is reached. This should constitute the permanent dosage. Whilst belladonna may be effective in some instances, it has the great disadvantage of producing a distressing sense of dryness of the mucous membranes of the upper air-passages which sometimes increases rather than diminishes the paroxysms. Quinin, in the hands of those who claim satisfactory results from its use, is given in courageous doses. Binz, who originated the treatment, gave as many centigrams of the hydrochlorate as the infant was months old or as many decigrams as it was years old. As much as 20 gr. per diem have been given to children five years of age. The drug, on account of its disagreeable taste, its tendency to disturb the stomach, and the bad effect it sometimes has upon the hearing, has received much adverse criticism. The chocolate quinin lozenge covers the taste admirably, but, like many tableted drugs, is uncertain in its action. It is much more reliable when administered in the usual hydrochloric acid solution. The only beneficial effect that I have achieved from the use of quinin has been in the later stages of the more chronic cases, when, in doses of from 3 to 9 gr. daily, it sometimes seems to check the paroxysms. Spirits of camphor in doses of from 5 to 20 min. daily is useful in cases in which there is a complicating bronchitis or circulatory depression. It is also useful in the beginning of the catarrhal stage.

Camphorated oil (1 part of camphor to 9 of sterile olive oil), given hypodermically in doses of 3 to 10 min. according to the age, is one of the most useful stimulants for administration in the alarming attacks of cardiac depression which sometimes follow the prolonged and violent paroxysms of coughing.

At the time bromoform was first suggested an extensive epidemic of pertussis prevailed in Philadelphia, and the drug was given a thorough trial in one of my clinics. The results were unsatisfactory and, after several instances of mild poisoning, its use was discontinued. It was administered in the form of an emulsion in doses of from $\frac{1}{2}$ to 3 min. three times daily, according to the age of the patient. It is probably more advantageously given dropped on a lump of sugar (Holt). It seems to have acted more favorably in the hands of other observers.

The antispasmodics as a class are helpful in allaying the nervous irritability which attaches to the disease. A nightly dose of croton chloral hydrate or bromid of potash (3 to 10 gr.) will often contribute much

toward overcoming an existing insomnia. Trional and sulfonal may be administered occasionally in milk in the late afternoon in doses of from 3 to 5 gr. for the same purpose.

Eustace Smith relies upon chloral "above all other drugs" in the general treatment of the disease. He gives it in doses of 1 gr. every two, three, four, or six hours, according to the patient's age. He has also had favorable results from the sulphate of zinc. He gives it with liquor atropiæ (B. P.), which probably shares largely in the favorable results.

Opium and its derivatives, the best of which is codein (gr. $\frac{1}{24}$ to $\frac{1}{8}$, three times daily), may be given, and they unquestionably act well upon the cough. Triboulet and Boye[1] have applied and strongly advocate the use of the hydrochlorate of morphin subcutaneously. They give one injection daily for a series of three days, then after an interval of three days, the daily dose is repeated for another three days, and so on until convalescence is established. The dose varies from $\frac{1}{26}$ gr. to $\frac{1}{9}$ gr., according to the age and effect. Marfan[2] reports favorably upon this treatment, but Comby[3] found nothing of value in its use. Nephritis is the only contraindication. A personal prejudice against the use of opium preparations in children has led me to give them only as a last resort.

Caillé, Hurion, Delherm, Comby, and others recommended ozone inhalations. They claim that they shorten the duration and lessen the severity of the disease. Vaccination has been recommended, especially by the Italian School (Pestalozza, Pesa, Celli, Bologium, Poschi, Dietric, and Kabylie), both as a prophylactic and curative measure. Some of the results reported have been striking; others have failed to note any influence. The observations of Storch, Fogel, and Richter, who saw pertussis epidemics checked, children rendered immune, and obstinate cases cured by the occurrence of small-pox, would seem to lend support to this treatment.

One could write indefinitely upon the innumerable measures which have been recommended for the treatment of pertussis, and collate favorable results in every instance, but one can state the consensus of opinion regarding the majority in few words: None of them are specifics, and the ones mentioned in detail maintain the preference among the best pediatrists of the world.

Symptomatic Treatment.—Beyond the measures already indicated it is sometimes necessary to resort to inhalations of chloroform or nitrite of amyl to control the prolonged and frequently recurring paroxysms. Cadet de Gassicourt,[4] Nanwelaer,[5] Levassort,[6] and de Rothschild[7] each report instances in which the paroxysms ceased permanently following chloroform anesthesia. de Rothschild claims good results

[1] Triboulet and Boye, Bull. de la Soc. de pediat., 1908, p. 123.
[2] Marfan, Ann. de med. et chir. infantiles, 1909, vol. xi, p. 739.
[3] Comby, Gaz. des maladie enfantiles, 1909, vol. xi, p. 129.
[4] Cadet de Gassicourt, Dictionnaire de Jaccoud.
[5] Nanwelaer, Bull. médicale, 1906, p. 861.
[6] Lavassort, Jour. de méd. de Paris, 1906, 2 S., vol. xviii, p. 534.
[7] de Rothschild, Soc. méd. des hopitaux, May, 1906.

from the routine use of chloroform anesthesia. Nanwelaer, however, was disappointed in his results. These are remedies which cannot be long continued and should be considered extreme measures.

The vomiting sometimes requires further attention. For this purpose small doses of cocain hydrochlorate—$\frac{1}{6}$ gr. twice daily to a child of one year (Eustace Smith)—are useful, especially when the vomiting occurs independently of the paroxysms.

Kilmer, with reason, recommends an elastic abdominal belt for its effect upon vomiting. Kerley has corroborated his results. Aside from the good effect it may have upon this symptom, it ought to serve a useful purpose as a mechanical support in infants and children having marked relaxation of the abdominal wall, and contribute to the control of the abdominal pain which is such a common result of the paroxysms. In the rare instances in which the vomiting prevents alimentation through the mouth, rectal feeding must be resorted to. The utmost care must be exercised to prevent expulsive irritation of the rectum. The enemata should consist of small quantities of predigested milk. All drugs should be withheld save such as are needed for stimulation and these should be administered subcutaneously.

The treatment of such complications as bronchitis, pneumonia, and the various nervous lesions fall under the treatment of these conditions and are considered in other chapters.

The nasal hemorrhages are practically the only ones requiring special attention. When obstinate, the nares should be tamponed.

Constipation should be corrected by mild remedies. In infants suppositories or enemata are usually sufficient. In older children mild laxatives may be given. An occasional course of calomel is useful, not alone for its effect upon the bowels, but as well for its stimulating action upon the metabolic processes. Diarrhea should be promptly checked. Spasm of the glottis, as well as severe and threatening paroxysms, are best controlled by intubation, as practised by O'Dwyer. Eustace Smith states that the spasm of the glottis will quickly relax if the patient's hands are placed in cold water. Tonic treatment—iron, arsenic and strychnin, cod liver oil, etc.—should be begun in the stage of decline. The diet should be increased in amount as convalescence advances. Every effort should be made to improve the nutrition in order to protect the patient against serious sequelæ.

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MUMPS

By Samuel McC. Hamill, M. D.

Mumps is an acute infectious disease. Capitan and Charrin and Olivier and Boinet found a spheric, sometimes elongated, motile bacillus in the blood of patients ill with mumps, and Bordas, a bacillus with swollen extremities.

Laveran and Catrin, in 67 out of 92 cases, recovered from some of the following sources—the blood, punctures of the parotid gland, and orchitic fluid—a non-motile micrococcus sometimes grouped in pairs and fours having a diameter of 1 to 1.5 micromillimeters, which did not stain with Gram's.

In the same year (1893), Anthony[1] isolated an organism which he considered identical with that of Laveran and Catrin. Mecray and Walsh[2] in 1896 described a diplococcus which they had isolated from human beings infected with mumps, and Busquet[3] a diplostreptococcus. In 1897 Laveran[4] reported the finding of a diplostreptococcus in the saliva of a dog suffering from enlargement of the parotid glands, which he had developed fifteen days after his master had been attacked by mumps. He later observed several cases of the same character in dogs.

Shortly thereafter Michaelis and Bein[5] isolated a diplostreptococcus having the same characteristics, from the saliva of 16 cases of parotitis. In 2 of these this organism was obtained in pure culture from the pus of parotid abscesses, and in 2 from the blood.

For several years following this date, the etiology of mumps did not receive much consideration. In 1896 Teissier and Esmein[6] studied several series of cases selected from different epidemics, occurring over a period of eighteen months, and scattered over all parts of Paris. In the blood of a majority of these and in the catheterized saliva of many, they found a diplococcus, which they thought to be the same organism described by Capitan and Charrin. They also thought that they established the identity of this organism with that of the micrococcus tetragenous septicus. They also found certain similarities in the pathologic lesions induced in animals infected with this organism, and in those of

[1] Anthony, Rapp. a la Soc. des med. hopit., February 24, 1893.
[2] Mecray and Walsh, New York Medical Record, 1896, vol. l, p. 440.
[3] Busquet, Revue de méd., 1896, No. 9, p. 744.
[4] Laveran, Bull. de l'Acadamie de méd., 1897, No. 40, p. 255.
[5] Michaelis and Bein, Separatabdr. aus den Verhandl. des XV, Kngr. f. Inn. Med. z. Berl., 1897.
[6] Teissier and Esmein, Compt.-rendus de la Soc. de biol., 1906, vol. lx, pp. 803, 853, and 897.

fatal cases of mumps. Using the serum of convalescent patients they made eleven positive agglutination tests in 12 cases in dilutions of 1:50 and 1:200. Their controls were all negative except one in which there was a slight agglutination in a dilution of 1:25.

In 1907 Korentschewsky[1] described an organism which he thought to be the same as that described by Teissier and Esmein. It was agglutinated with the serum of parotitis patients in dilutions of from 1:40 to 1:100. Control experiments upon normal individuals were negative, and he was unable to produce the disease in mice, guinea-pigs, rabbits, or dogs.

The fact that all of the investigators engaged in the study of the etiology of this disease since 1895 have discovered organisms which bear such a striking similarity to each other, strongly suggests, as Teissier and Esmein have pointed out, that they have been working with the same organism.

As to its etiologic relationship, the majority seem to think it very probable that it is the essential cause of mumps, but apparently none of them consider the proof which has accumulated sufficient for a final decision.

The morbid anatomy is little understood because the disease is so rarely fatal. Virchow thought the primary lesion a catarrh of the duct. Jacob noted that the glands themselves were not enlarged, but that their surrounding cellular elements were filled with a greenish, gelatinous, transparent, lymph-like substance, which produced the lardaceous consistence of the glands. Ranvier, in a microscopic examination, found no evidences of inflammation, no catarrh of the duct, no cellular proliferation, but an edema of the glottis and of the periparotidian cellular tissue. It is generally thought, however, that the mucosa of the duct is inflamed and sometimes the gland itself, but that the chief lesions are hyperemia and edema.

Suppuration is rare and is due to accidental infection with pyogenic organisms. The parotid on both sides is usually affected; more rarely the submaxillary and sublingual.

The glandular or periglandular lesions produce the striking symptoms of the disease, the pain, swelling, and sialaporia. The other manifestations are dependent upon the bacterial infection.

The disease occurs in all parts of the world at all seasons of the year. It is endemic and epidemic. It is less contagious than the other infections of childhood, and is transmitted only by direct contact, which results in the epidemics being less widespread than in the case of most infections.

It is contagious early in the attack and for some days after the swelling has subsided. It is not definitely determined, however, when the cases cease to be infectious, but three weeks from the onset is accepted as covering the period. It occurs almost exclusively in children from the age of two years up to puberty. It is very rare before the second year, although authentic cases have been recorded as occurring in intra-

[1] Korentschewsky, Centralbl. f. Bakt. u. Parasitenk. (originale), 1897, vol. xliv, p. 394.

uterine life (Human) and during the first weeks of life (Gautier, Demme, and Koplik).

The infection is usually mild, especially in young children. The local symptoms, pain and swelling, are frequently the first evidences of the disease. The symptoms increase gradually for two or three days, continue unchanged for an equal period of time, and then gradually subside. Both sides are generally affected, usually at intervals of several days. In the severe cases the swelling may be extreme.

Occasionally the onset is severe and attended by vomiting or convulsions, high fever, and followed by serious and, exceptionally, fatal consequences.

The principal complication is orchitis, which occurs almost exclusively in adolescence and adult life. Nephritis, multiple nephritis, meningitis, facial paralyses, endocarditis, and thrombosis of the sigmoid and cavernous sinuses have been noted.

The main objects of treatment are the isolation of the patient, the control of the pain, and the prevention and treatment of the complications.

TREATMENT

As in all infections, the first measure of treatment is the prevention of its spread.

Prophylaxis.—While the disease is usually mild in its course, it must be remembered that the infection is occasionally serious, even fatal, and that dangerous complications sometimes occur. For this reason the patients should always be isolated immediately upon the recognition of the condition, and kept from contact with children and adults for a period of three weeks from the onset of the disease. The rules governing the isolation should be those set down in the article on Preventive Treatment in the first part of this work. The infecting organism is so short lived that fumigation of the apartment after quarantine is lifted is unnecessary. Thorough airing and cleansing are sufficient.

There are no known remedies which influence the development of the microörganism, nor has any antitoxin been discovered to counteract the systemic effect of the toxins. Assuming that infection occurs through the mouth, it is advisable to keep the mouth cleansed and, as far as possible, protected by an antiseptic mouth-wash. If it does nothing more, it adds to the patient's comfort by relieving the disagreeable dryness of the mouth. One should keep a close watch upon the eliminative organs. The bowels should be relaxed, the kidneys stimulated by the free administration of water, and the skin kept healthy by daily sponging with warm water. A liquid diet should be given, not alone to relieve the local distress induced by solid food, but also to lighten the duties of the organs of digestion and elimination. Rest in bed is essential during the febrile period.

Symptomatic Treatment.—The treatment is mainly symptomatic, and the symptom requiring most consideration is pain. This is always present to some extent and sometimes is very severe. It is best combated

by cold applications. Ice poultices constitute the best form of administration. In young children warm applications in the form of cloths moistened in hot water and frequently changed, hot dry woolen cloths, or hot poultices may serve a better purpose. The protection of the gland by cotton wool or the application of belladonna, either in the form of an ointment or liniment, is helpful.

When the temperature is very high and the constitutional symptoms severe, the surface of the body may be sponged with cold water (90° to 75° F.).

If the nervous symptoms are not influenced by this measure, they can usually be controlled by appropriate doses of the bromids. Where pain and fever interfere with sleep, small doses of trional (3 to 5 gr.) or chloral hydrate (2 to 5 gr.) may be given.

Complications.—Much can be done to prevent the occurrence of complications by carefully carrying out the treatment above indicated. The testicles should be inspected from day to day and, if any pain or tenderness is noted, they should be immediately supported and protected by cotton wool. Warm applications may be used to the patient's comfort.

The urine should be frequently examined. If nephritis occurs, the treatment becomes that of this condition. This statement applies equally to the nervous and cardiac complications indicated.

If suppuration of the gland is threatened and advances regardless of the cold applications, it should be encouraged by the use of poultices and an early free incision made under antiseptic precautions.

Deafness, which is not uncommon, is usually due to injury of the auditory nerve from a lesion of the labyrinth. The onset is sudden and marked by vertigo and vomiting. Such symptoms should lead to a careful examination of the ear by one qualified to recognize and treat obscure lesions.

Convalescence requires tonic treatment and change of climate. Iron, in a digestible form, is essential, as an anemia of considerable degree frequently follows the disease.

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MILIARY FEVER

By Samuel McC. Hamill, M. D.

Miliary fever is an acute infectious disease, which has recurred from time to time in epidemic form ever since the extensive and fatal epidemic which visited England in 1480.

The nature of the infecting organism has not been determined. The epidemics, especially the more fatal, have occurred in country districts where opposition to post-mortem investigation has been great, and where autopsies were obtained, the characteristic post-mortem decomposition, which begins within a few hours of death, rendered the studies difficult and, to some extent, vitiated the results. Notwithstanding these obstacles, various attempts have been made to determine the bacteriology.

Drasche and Weichselbaum, during the declining stage of the epidemic of Gurkfeld in Krain in 1892, made some bacteriologic studies of the fluid and blood from the vesicles and papules and from the heart's blood and certain hemorrhagic areas discovered in the organs of one cadaver. Their results do not seem to have been published, although Netter and Immermann quote them as having been negative.

Justin Lamaistre, in the epidemic in Bussiere-Poitevine in Haute Vienne, made cultures from blood taken from the papules on the chest and extremities and from the sweat and the contents of the vesicles. In all he found a coccus which sometimes appeared in the form of a diplococcus and again in short chains. It was motile and resistant to considerable ranges of temperature, which led him to believe that it was capable of living in and being transmitted by drinking-water. He made no post-mortem studies and no animal inoculations.

During the Hohnweiler epidemic, Zeller made cultures from the mesenteric glands, the liver, spleen, and kidneys of 5 fatal cases, including an infant born with the disease, and the placenta from this case. In all the inoculations he obtained a pure growth of a bacillus belonging to the colon group, which proved pathogenic for white mice. He found the same organism in a number of spring and well waters. Whether the presence of the bacillus in the water indicated that it was the cause or the consequence of the disease was not determined. In either event, if etiologically related to the disease, its presence there would threaten a continuation of the outbreak.

Brouardel's Commission examined the blood of patients with negative results. Parrot, Borgi, and others inoculated the contents of the miliary vesicles into healthy individuals in the hope of directly convey-

ing the disease, with negative results. This would seem to show that these do not contain the infecting agent in a virulent form and to weaken the findings of Lemaistre.

Very little was added to our knowledge of the disease during the epidemic of 1906. The bacteriologic studies of Weichselbaum,[1] as well as those of Scholz,[2] and Chantemesse, Marchaux, and Haury[3] have thrown no light upon the etiology.

The last named authors observed that the infected districts had been inundated prior to the outbreak, and that in consequence there had been a decided pest of field and water rats. They further observed that the patients were extensively bitten by fleas. They thought it possible that these rats were susceptible to and at the time were infected by the organism which produces the disease, and that they had infected the fleas of the district, which in turn had transmitted the disease to human beings. They were unable to study any of these animals as they had entirely disappeared from the district before they began their investigations.

The principal morbid changes which have been noted are the early and rapid decomposition of the cadaver, the dark color and delayed or absent coagulability of the blood, hemorrhage into the mucous membrane of the stomach and trachea, lungs, and endocardium, marked congestion of all of the internal organs of the body, acute swelling of the spleen, cloudy swelling of the liver and kidneys, fatty degeneration of the heart, and inflammatory swelling of the lymph-follicles.

Miliary fever has followed the course of many of the plagues of earlier times by gradually lessening in the frequency and severity of its outbreaks in response to the improved conditions of advancing civilization.

The recent epidemics have been limited to certain parts of France, Germany, Italy, and Austria. The last occurred in 1906 in southwestern France in the Districts La Charante, La Charante Inferieur, and Les Deux-Sevres, and in February, March, and April, 1900, there was a less severe epidemic in Hohnweiler. Extensive epidemics occurred in France in 1887 and in Austria in 1892. The disease has never appeared in the United States.

The disease attacks both adults and children. In some epidemics the majority of the cases have been in children and in others in adults.

The onset of the disease is sudden, often ushered in by a profuse sweat. Its principal symptoms are the sweating, epigastric pain, respiratory anxiety, often amounting to almost suffocation, constipation, insomnia, the characteristic eruption (occurring first on the face, from the second to the fourth day, primarily as small papules on a reddened base, which soon becomes vesicular and resemble sudamina. Desquamation, branny or in large scales, begins shortly after vesiculation occurs and is completed rapidly). Convalescence is uncertain, owing to the

[1] Weichselbaum, Zeit. f. klin. Med., 1907, p. 21.
[2] Scholz, Zeit. f. klin. Med., 1906, p. 542.
[3] Haury, Bull. de l'Acad. de méd., 1906, vol. lvi, 35, p. 293.

tendency to recurrence of the symptoms. At best there is profound depression, from which recovery is slow. The acute manifestations usually end in from ten to fourteen days.

TREATMENT

The infectious nature of the disease, its possible contagiousness (Royer, Loreau, Ruhlmann, Brouardel and Immermann), and the fact that we do not know its cause, indicate the following divisions of the treatment: 1, Prophylaxis; 2, treatment of the symptoms; 3, treatment of the stage of convalescence.

Prophylaxis.—Owing to the frequent occurrence of these epidemics in the country districts, where the people and the profession are not educated to the needs of the occasion, nor possessed of the measures necessary to combat the situation, and because the disease spreads with such rapidity and the epidemics are occasionally so fatal, governmental prophylaxis is usually demanded.

Rigid sanitary regulations should be promptly established. Infected districts and all infected houses therein should be quarantined and all patients strictly isolated. Where it is possible, the sick should be removed to properly constructed emergency hospitals. The houses from which patients are removed should be fumigated and all infected bedding and clothing either destroyed or disinfected and fumigated. Brouardel and his Commission established a central fumigating plant to which all infected materials were taken, a measure which was considered much more effective and economic than the house to house method. On account of the uncertainty of the maximum period of incubation, infected houses should be quarantined for a period of at least two weeks.

Where the patients are treated in their homes, the regulations should be those governing all infectious diseases.

Since we do not know what microörganism produces the disease, its probable characteristics, nor its manner of entering the body, it is quite apparent that we are unable to do much toward inhibiting its growth. The profuse sweating, usually seen in this condition, is probably an attempt on the part of nature to dispose of the toxic products which are being so rapidly generated in the body. We can do little to aid this process because the sweating renders the patient so weak that any attempt to stimulate the other organs of elimination is not well borne. The kidneys, which are usually inactive, may be stirred up by the free use of water, which has the additional advantage of quenching the existing thirst and making up for the great loss of fluids through the skin.

In those cases in which the sweating is suddenly checked in the course of the disease, that is, before convalescence is established, much can be done by the use of measures to induce sweating, avoiding pilocarpin on account of its depressing effect upon the circulation.

The milder cases require little medication. Careful rest, proper diet, good nursing, and constant watchfulness for the development of dangerous symptoms meet all the requirements.

There is no specific treatment, although certain drugs have been given for their good effect upon the general course of the disease.

Formerly miliary fever was thought to be etiologically related to malarial fever. This idea was responsible for the exploiting of quinin as a specific. Although a useful drug in the treatment of the disease, it has no specific action. In large doses it has seemed to influence the temperature and the nervous phenomena.

Reibel recommended the use of mercurial frictions. The bichlorid of mercury was also lauded by Eisenmann at an earlier date.

Ruhlmann (Ibid.), noting the relief obtained by vomiting caused accidentally in administering quinin, experimented with powdered ipecac as an emetic. The results were so satisfactory that he resorted to this measure whenever the epigastric pain, the high temperature, and nervous phenomena increased. He was able to influence the severity of the attack by early and repeated administration of the drug. Rochard, who found quinin ineffectual, obtained excellent results from the initial administration of 1.50 grams of the ipecac, sometimes repeating it in the course of the disease. This remedy has been used with considerable frequency and variable results (Jaccoud, Guerin, Foucard, etc.).

Symptomatic Treatment.—The symptoms most often requiring attention are high temperature, profuse sweating, kidney insufficiency, epigastric pain, constipation, the nervous phenomena (respiratory anxiety, delirium, insomnia, etc.), and the vascular depression. Hyperpyrexia is common in the severe cases and is best controlled by the use of cold. It may be applied in any of the common methods, sponging, tub-baths, cold effusions, packs, and compresses. Baths also have a very favorable influence upon the nervous symptoms, which are often dependent upon the fever. Tepid baths, to which alum and vinegar have been added, have been used for their good effect upon the hyperidrosis. Schoenlein, with the idea of neutralizing the acid sweats, had his patients sponged with a solution of caustic potash (1:20). This measure has been used with good effect by many since his time, although Immermann considers it useless.

Daudet and Grener recommended the perichlorid of iron on account of its influence upon the sweating. Both this preparation and the tincture of the chlorid have been liberally used since and with good results.

It is essential that the patient be kept in a cool, well ventilated room with very light covering. The old method of heated rooms and heavy bed clothes, applied for the purpose of favoring perspiration, has long since been abandoned. It is necessary, when the sweating is threatening life by completely checking the action of the kidneys, to control it with atropin. It usually acts well, but must be given watchfully, as too abrupt checking of the action of the sweat glands may give rise to alarming toxic symptoms. The kidneys must be stimulated at the same time in the manner above indicated.

The epigastric and cardiac pains and the suffocative symptoms are usually controlled by sinapisms or the local application of ice. Where

these fail and the pain becomes alarming, morphin may be given hypodermically.

Constipation, which is an almost constant symptom, is best overcome by the use of enemata or mild laxatives. Severe purging, on account of the depressing nature of the disease, must be avoided. Stimulants are required in the severe cases. Some authorities strongly advise alcohol, while others, on account of its tendency to produce cutaneous congestion, oppose its use. Strychnin is a better drug, especially where there is marked respiratory depression, and where the continuous use of a stimulant is required. If collapse is imminent, the hypodermic use of strychnin or oil of camphor is indicated. Insomnia may be controlled by any of the non-depressant hypnotics.

Treatment During Convalescence.—On account of the tendency to relapse, the stage of convalescence requires judicious handling. The patient must be kept bedfast until the tendency to sweat has ceased and desquamation is ended. Sponging of the surface should be continued, and, if the skin shows a tendency to become dry, oil inunctions are acceptable. Exposure to draughts or cold and damp air must be guarded against. The diet must be increased gradually, using as an indicator the return to normal of the general bodily functions.

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GLANDULAR FEVER

By Samuel McC. Hamill, M. D.

E. Pfeiffer in 1889 described a symptom complex to which he gave the name glandular fever. While commonly referred to in text-books since that time, there has nevertheless been much doubt expressed as to the justifiableness of considering this group of symptoms a distinct disease.

Nineteen years after his original communication, Pfeiffer[1] again discusses this subject, calling attention to the fact that he had no thought of claiming anything specific for the condition at the time he first described it. Incidentally also, he points out that many of the conditions which have been described as glandular fever have had very little resemblance to the clinical picture which he defined in 1889.

In any event the term has proven a convenient one under which to classify some of the irregular forms of acute enlargement of the cervical lymph-nodes.

These glandular enlargements occur endemically and also, in small, usually house, epidemics. Occasionally they have been more widespread, as in the epidemic recorded by Park West.

Children are more susceptible than adults, although the latter are occasionally attacked.

Various microörganisms: the streptococcus, the staphylococcus, the pneumococcus, and influenza bacillus have been found in cultures from the mucous membrane of the throat and the blood in these cases. Probably all of these and others are capable of producing the lesions and symptoms grouped under this heading.

The infecting organism locates itself primarily in some portion of the upper air-passages, from whence it is carried to the various glands encircling the neck by the numerous afferent lymph-vessels draining these regions.

Redness, swelling, and sometimes an exudate exist as local lesions of the upper air-passages. The principal morbid process is the inflammatory enlargement of the glands, most often one or more of the deep cervical glands, posterior to or just beneath the sternocleidomastoid. All of the glands receiving afferent vessels from the mouth, nose, nasopharynx, tonsils, pharynx, and larynx may be involved. The inguinal and mesenteric glands have been found enlarged and the spleen and liver occasionally tumefied. Suppuration has been noted by Neumann, Comby, and others, but its occurrence must be considered rare.

[1] Pfeiffer, Verh. d. Kong. f. Inn. Med. Wien., 1908, p. 539.

It is not definitely determined how the infection is transmitted, and it probably depends to some extent upon the microörganism responsible for the individual attack. Unquestionably, it has been contagious in some outbreaks.

Its duration varies from one to four weeks. Its onset is sudden, often accompanied by a chill or chilly sensations, vomiting, and joint pains. The principal symptoms are mild redness and swelling of the mucous membrane of some portion of the upper air-passages, high fever, swelling, and tenderness of the upper deep cervical lymph-nodes, constipation, and the symptoms common to all severe infections, such as fever, restlessness, headache, etc.

The rare fatalities are due to the complications, the chief of which is nephritis, which usually covers from ten days to four weeks. Various skin eruptions, otitis media, and retropharyngeal abscess have been recorded; while pertussis, bronchopneumonia, scarlet fever, and bronchitis have been observed during the course of the disease.

The purposes of treatment are to prevent the spread of the infection and to counteract the damaging effects of the toxemia.

TREATMENT

The infectious and probably contagious nature of the condition emphasizes the necessity of careful preventive measures. As house epidemics are so common, the removal of the uninfected not only from the patient but also from the premises, in order to avoid a common source of infection and the thorough investigation of local conditions, becomes necessary.

In the main the preventive treatment should be that of all the infections.

The probable multiple and uncertain bacteriology of these glandular infections keeps us in the dark as to the best methods of controlling the development of the microörganism. No specific has been discovered empirically and no antitoxin has been produced. As in all conditions in which infection is thought to occur through the upper air-passages, local cleansing and antiseptic treatment should be inaugurated, with the idea of curing manifest lesions and of preserving the mucous membranes in a healthy condition. The eliminative organs should be carefully watched.

Symptomatic Treatment.—Constipation, which is commonly present, should be controlled by small doses of calomel, a remedy which seems to act well upon the general course of the disease (West). The pain and glandular swelling are best controlled by ice poultices. When used early, they seem to influence the degree of swelling and to prevent suppuration. The febrile period is usually of such short duration and the degree of temperature such that special measures for its control are unnecessary. In those instances in which it is associated with serious nervous symptoms, cold sponges may be given and the bromids administered internally. As in all infections in children, associated with

high temperature and cold and congested extremities, it should be borne in mind that hot baths, by equalizing the circulation, will often allay very alarming symptoms and reduce temperature where cold baths or applications have failed.

Complications.—The urine should be carefully and frequently studied. When nephritis occurs, the measures usually applied in this condition should be resorted to. The glands should be frequently inspected, and if suppuration occurs an immediate free incision should be made, whether it be of the deep cervical or retropharyngeal groups.

Daily inspection of the ear-drums is necessary and if the slightest evidences of redness with bulging are noticed, especially if associated with pain or increase in the temperature, a free incision should be practised and appropriate after-treatment established.

This disease, even the mild attacks, is followed by a disproportionate degree of depression and anemia, which mark the necessity of supportive and tonic treatment during convalescence. For this reason strychnin and iron, change of air, careful regulation of the diet, and exercise require due consideration.

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DYSENTERY

By Charles F. Martin, M. D.

Even in the light of our recent knowledge of dysentery the term must still be regarded as a purely clinical one, implying a symptom rather than a single pathologic entity. It is associated chiefly with a condition in which there are frequent small diarrheal stools containing mucus and blood, and accompanied by tenesmus and abdominal pain. Anatomically, there may be catarrhal, diphtheritic, or ulcerative changes.

The more recent work that has been done by Shiga, Flexner, and others renders the etiologic classification clearer; nevertheless, the older clinical distinctions of endemic, epidemic, and sporadic dysentery still hold, as do also those of acute and chronic. In the present state of our knowledge we may recognize three pathologic varieties of the disease—catarrhal, ulcerative, and diphtheritic; but an etiologic clinical classification is perhaps best:

(1) *Chemical*, from irritating foods, metals (Cu, As, Hg, Pb); products of defective metabolism (uremia); toxins of certain vegetable growths (mushrooms). Perhaps all these have a bacteriologic association as well, and, in some at least, pathogenic bacilli have been associated with the lesions.

(2) *Bacterial or bacillary* (Shiga, Flexner, Kruse, also B. pyocyaneus).

(3) *Protozooal* (Amœba coli, Balantidium coli, Kalazoa (India), Malaria).

(4) *Verminous* (flukes, nematodes, etc.).

Historically, dysentery is among the oldest of described diseases, and reference to its symptoms and treatment is made in the Papyrus Ebers, 1600 B. C. As an epidemic its history dates from before Herodotus and its name was given by the Greeks. Hippocrates was the first to describe it as an infection. As regards the geographic distribution, Ayrs has commented on the fact that "Of dysentery it may be said, where man is found, there will some of its forms appear." Although commonest in the tropics, where it is endemic and epidemic, it appears in other regions as well, and is frequently seen in the countries of Africa and Asia, in Japan, North and South America, and in various portions of Europe, especially Greece and Italy.

Simple Catarrhal Dysentery (With or Without a Known Etiology).—Here the lower bowel is chiefly affected; there is hyperemia with

hemorrhage, desquamating epithelium, mucus, pus, and red cells on the mucous membrane, and there may be shallow ulcers and infiltration of the submucosa. The duration is usually limited to nine or ten days, and the main features consist of malaise with some fever, weakness, loss of flesh, anorexia, abdominal pain and tenesmus, with frequent small stools containing mucus and blood. It is commonest in children, is sporadic, and associated with dietetic errors, great heat, and often with the invasion of various bacteria.

The Bacterial Form.—Chiefly associated with the bacilli in their various forms described by Shiga, Flexner, Kruse, Duval and Bassett, et al. The bacilli have slight differences in their cultural peculiarities, but are in general features more or less similar, and each pathogenic of this disease. Shiga discovered the bacillus of dysentery in 1897, during a Japanese epidemic, finding the small motile organism in the intestinal contents, the walls, and the mesenteric glands. At the end of the first week of the disease it may be found in almost pure culture in the fresh stools. It is always present in this disease and is not associated with any other malady. Shiga also found that the bacillus might live for months in a moist shady soil, and for many weeks in water, a recognition of which is important for prophylaxis. It is, however, easily killed by ordinary antiseptics. The bacilli become agglutinated in contact with the serum of patients suffering from bacillary dysentery, in the proportion of 1:10 in mild and 1:130 in severe cases. Agglutination begins in the second and third week, and is, therefore, of very little diagnostic value, but for prognosis it is recognized as favorable if the appearance of the agglutinative power be sudden or be rapidly increased. The agglutinating power is still under discussion. Pillsbury has found non-dysenteric serum sometimes causing agglutination of dysentery bacilli, but only in strong solutions. Also the agglutinating power of different types of dysentery bacilli varies. In 1901 Shiga prepared an immune serum from horse's blood which seemed to possess protective and therapeutic properties.

Flexner, in 1899 in the Philippines discovered a bacillus resembling Shiga's, with specific agglutinative powers, and he prepared a curative serum. He concluded that acute cases were scarcely ever due to the ameba, that the Shiga bacillus was the cause of the epidemics in Japan, but that *no one bacillus is the specific cause in all cases.* Probably sporadic and epidemic cases are caused by different germs. Moreover, the subacute and chronic types he regarded as due to various causes, partly bacterial and partly amebic, and certainly that in the amebic dysentery bacterial association has much to do with the pathogenic powers of the ameba. The conclusive evidence of the pathogenicity of Flexner's bacillus for man in the production of acute dysentery was given by Strong and Musgrave in their ingestion experiments on the condemned criminal in the Philippines. The swallowing of a pure culture of the bacilli resulted in an acute attack, with the presence of the germs in the stools, and ultimate recovery.

The bacillary form, though endemic in Japan and the Philippines,

may be epidemic and sporadic. It is now pretty universally recognized that even the institutional varieties of dysentery are caused by the bacillus in one or other of its modifications.

Infantile diarrheas are in many instances of the same bacillary origin, and in a large series of summer and winter diarrheas of infants the specific organism has been found, and this, too, not only in the severe cases, but in many of the milder types so that the prevalence of the germ is proving ever more widespread.

The organism, however, seems uncommon in the alimentary flora of healthy children, nor has its regular habitat outside of the body been discovered.

The acute variety affects especially the colon and the sigmoid flexure, and there are usually hyperemia, swelling of the mucosa, and superficial erosions and necrosis rather than deep ulcerations. The ileum is often affected for 4 or 5 inches in its length and the serosa is somewhat injected. The lymph-glands are often enlarged. The bacillus of Shiga, or of Flexner and others, may be found in the dejecta, in the mucous membrane itself, and sometimes in the lymph-glands. In the subacute form there is no definite ulceration, merely superficial erosion; there is less reddening and more thickening, and there may be a pseudomembrane with coagulation necrosis. In the chronic form, on the other hand, the mucous membrane of the colon is purple, not red, there are hemorrhages, perhaps erosions, but there is no "undermining." Uneven thickening of the mucosa occurs, but, as a rule, there is no pronounced ulceration.

The Amebic Form.—The ameba coli, *Entamœba histolytica* (Schaudinn), is usually found as the main cause of the affection. This is usually more subacute or chronic in type, though sometimes very acute types occur. The disease affects the lower bowel irregularly, the cecum and sigmoid flexure being especially diseased. There are hyperemia and swelling of the mucous membrane, which is covered with blood and mucus; the serosa is infiltrated; the follicles project, and there are ulcerations of various forms and size, with overhanging edges, extending often to the muscle and rarely causing perforations. The ameba are found in the advancing zone. Healing, when it occurs, is accompanied by fibrosis and often by stricture of the bowel. It is common in this form of disease to find liver abscess as a complication, and such cavities contain glairy fluid with few pus cells. In the acute abscess there is not much evidence of reaction, and in the chronic abscess there is much fibrosis. Sometimes the diaphragm is affected, and extension proceeds to the lower lobe of the right lung, where an abscess is apt to form and anchovy-sauce-like sputum is coughed up. There is usually no sign of Shiga's bacillus with the ameba.

The Diphtheritic Form (Secondary).—Pseudomembrane is formed on the surface of the lower bowel, chiefly on the rugæ and projecting folds of the flexures and the rectum. Fibrin, pus cells, and degenerated epithelium are present in abundance, and on removal of the false mem-

brane shallow losses of substance may be detected. Rarely the ulceration is quite deep and even perforation may take place. A characteristic type of this variety is seen in uremia. The symptoms are variable and by no means constant, as in other varieties of dysentery. Diarrhea is often absent.

The **symptoms** of the various forms of dysentery present certain features in common. As a rule, there are no prodromata, though there is sometimes slight gastro-intestinal disorder, and after a natural stool there are several diarrheal evacuations without tenesmus or pain. Gradually there are more stools, and smaller, with mucus and blood, and in the dejecta are found epithelium and large swollen epithelioid cells. Soon there come abdominal pains with borborygmi and tenesmus. At first the general condition of the patient is unaltered, but soon there is abdominal distention with irregular fever; the pulse is increased, the spleen is often enlarged, and there may be a trace of albumen in the urine. In several cases there may be a chill and fever, with anorexia, nausea, and depression, but usually there is no vomiting. The symptoms depend upon the site and extent of the disease. If fatal, it ends in four to fifteen days; if recovery takes place, the evacuations become less frequent, the blood disappears, there is less fever, and the patient is left thin. The appearance of the stools helps to a more complete diagnosis. In the chronic cases the character of the evacuations varies from day to day. Sometimes there are intermissions with fairly normal stools, and then a recurrence with mucus and blood. Various complications may occur in these chronic forms,—*e. g.*, chronic enteritis, liver abscess, liver necrosis, bronchopneumonia, general sepsis, etc.

TREATMENT OF THE BACILLARY AND "CATARRHAL" FORMS

Prophylaxis.—The etiology must be considered, and the ingestion of any causative factors must be avoided, especially in districts where the disease is prevalent.

Sterilization of water (especially surface water) and milk, and the proper cleansing of food stuffs are essential. Alcoholic excesses, overeating, or defective food are all to be eschewed. Each dysenteric patient is to be regarded as a focus of infection and should be isolated, the stools carefully examined for the variety of infecting organism, and then properly disposed of. All substances and materials which have come into contact with such patients should be disinfected, and the hands of attendants carefully cleansed. General hygienic rules should be followed and everything avoided which renders individuals susceptible. There should be no overcrowding, uncleanliness, overexertion and fatigue, exposure to moisture or heat or cold, or to any rapid transition of temperature. Appropriate clothing should be worn, and an abdominal binder is useful.

Both constipation and diarrhea predispose to dysentery.

Curative.—To effect a cure most rapidly the cases must be seen *early*. The later cases and more chronic ones are very difficult to cure,

and are, moreover, often attended by complications which are apt to terminate fatally.

The essentials in the treatment are briefly: (1) Rest; (2) early suitable purgation; (3) saline irrigation of the bowel; (4) restricted and non-irritating diet; (5) sedatives for the pain and medication for the intestinal mucosa; and lastly (6) when possible, specific serum. Rest is essential, and patients should not only be kept as quiet as possible in bed throughout the attack, but even movements in bed should be reduced to a minimum. For this reason the bed-pan should be used for evacuation of the bowels and the patient should not be allowed to rise. No matter how trivial the attack may appear, the patient should be kept in bed till its complete termination. Warmth with an equable temperature is likewise essential.

Local applications to the abdomen often afford great relief. Poultices, which are large and roomy, to cover the whole abdomen may be applied, or turpentine stupes, which should be renewed frequently before they become too cool. Sometimes tepid wet compresses may give relief instead, according to the method of Priessnitz.

Laxatives.—As already said, castor oil may be administered in early cases and often gives relief; 10 to 20 drops of laudanum may be added to the ½ ounce of oil. Great success, however, seems also to have followed the use of *salines*, particularly *sodium sulphate*, and there are many advocates for this form of treatment. It is especially useful in those that are ill nourished, in the young, and the pregnant. It may be given in doses of ½ to 1 oz. in the morning, and purgation will commence in a few hours—ceasing in about twelve hours—when a second similar dose may be administered unless contra-indicated because of weakness and fatigue. There is no need of excessive purgation inasmuch as moderate dosage gives excellent results, especially in the milder cases. Buchanan, in India, used 1 gm. of sodium sulphate in ½ oz. of aqua fœniculi till the stools became yellow. Birt prefers *magnesium sulphate*, while Richards and Washbourne, as well as Wyatt Smith, regard it as almost a specific. Dickie's method of administration seems to be most satisfactory: Magnesium sulphate, ½ oz. of a saturated solution, with dilute sulphuric acid, 10 minims in water, every two hours till the stools are copious, feculent, and free from mucus and blood. The addition of acid has the double effect of destroying or inhibiting the bacilli which cannot remain virulent in an acid medium, and, second, of producing constipation. There is a preparation used in Cape Town, viz., *tinctura monsonia ovata* (the dried plant 2½ oz. to 1 pint of rectified spirits), 1 dram of which is given every two to four hours till watery stools replace the blood. When this occurs, bismuth and Dover's powder is given instead, whereas, if bloody stools with mucus recur, magnesium sulphate is resorted to. This method, used by Buchanan and Poynder, is regarded with great favor.

Mercury.—Calomel as a useful drug in dysentery was introduced by Annesley and has since found much favor. Sir Patrick Manson employs it not infrequently in the following manner: 1 gr. calomel, combined with 1 gr. ipecac and 1 gr. opium, to be given every six hours. This

is especially useful in chronic cases. Plehn also strongly recommended its employment in the following manner: At first 1 oz. of castor oil is administered and followed by ½ gr. of calomel every hour for twelve hours, watching the gums; after three days, 7½ gr. of bismuth subnitrate are given every hour for three days, and then every two hours for a few days. The blue pill, used for a long period, is also efficacious under similar conditions; 2 gr. of the mass with ½ gr. of powdered opium every two hours till recovery takes place (usually two weeks). For children, fractional doses of calomel or other form of mercury are useful. One especially commendable method of its use is the perchlorid of mercury, 1 gr. in 10 oz. of water, this to be given in doses of 30 to 60 minims.

Sedatives.—There is a fair unanimity of opinion as to the efficacy of opium in some form. It may be given early as already mentioned with castor oil, in the form of laudanum; or, if there be excessive pain and peristalsis, a hypodermic injection of morphin may be administered. It is obvious that the dosage must be restricted in order to avoid retention of irritating materials by locking up the bowel. Sometimes an opium suppository is preferable, while at other times a Dover's powder fulfils all the requirements.

Other Medication.—The greatest diversity of opinion seems to exist as to the value of all other drugs, and even *ipecacuanha*, which for centuries was regarded as a sheet anchor for all forms of epidemic dysentery, is regarded as useless by some of the best informed authorities on this disease.

It is recommended by some in doses of ½ dram of the powder every few hours, according to tolerance. If not retained a second dose is at once administered, combined with an opiate, and one may then even increase the dose to 1 dram. Infants and delicate individuals cannot, of course, tolerate this form of treatment.

Some recommend its administration in keratin capsules in 20 gr. doses, three times daily, in acute cases only; or, it may be given as Dover's powder and combined with calomel or with bismuth.

Whether or not the de-emetinized variety is better, is still a matter of doubt.

Astringents (*by the Mouth*).—*Bismuth* is perhaps the only one which has given universal satisfaction. It should be administered in large doses (from 40 to 60 gr.) every four hours, with either Dover's powder or camphor, or with mucilage of tragacanth. Of late the colloidal bismuth has been recommended in doses of 10 to 15 gr. three times a day.

(For the use of astringents *locally*, in the bowel, see below.)

Antiseptics.—These are, after all, but a minor aid, and perhaps of more use in the later stages of the disease. Those which seem to have given most satisfaction are: salol in doses of 10 to 15 gr. three times a day; naphtalin, 15 gr. (in capsule) by the mouth every four hours, as recommended by Rossbach; benzonaphtol, 10 to 15 gr. (in capsule) three times a day, is also recommended; it breaks up in the intestine into betanaphtol and benzoic acid.

For *chronic* and intractable cases medicines are perhaps of less avail.

Many employ calomel as indicated above. Rutherford used pure *olive oil*, and with excellent results, which he attributed to the cholagogue action of the oil, which is both antiseptic and sedative. Thus, for the first three days 30 cc. were given three times daily, and milk was the only article of food; for the second three days 60 cc. three times a day, and the diet increased by 1 to 3 oz. of scraped beef or egg albumen. On the sixth day 60 cc. were employed every day; then 90 cc. or more three times a day, according to the conditions, for two months or more, the food gradually being increased as the oil is lessened. This method, used in the California Army Hospital, was found very favorable.

Hillier again found benefit from castor oil (℥j to ℥ij) and tincture of opii, 4 to 10 minims, given t. i. d., and used in addition to milk injections. Local irrigation, as mentioned later on, is of special benefit in chronic cases.

Irrigation.—Irrigation of the lower bowel, though apparently rational in all cases, is yet difficult to employ in acute cases on account of the irritation. It is well, therefore, to precede the irrigation by an opium suppository or cocain, and then to use at first small quantities of fluid at each occasion, two injections daily being probably sufficient. It is of benefit chiefly in those cases where the lowest portion of the bowel is affected, and if the irrigation is extensive it may be of great benefit. Rectal irrigation, if it is to be done at all, should be done properly—the buttocks should be raised, injection should be given slowly, and the patient should be directed to retain it if possible for twenty minutes. This should be given twice a day, and if there be tenesmus, morphin should be first administered. The irrigation is especially indicated for large putrid stools which are frequent, rather than for those cases where there are small mucous ones. Hot injections are probably better than cold, being more sedative. Various preparations are used for irrigation, though a simple saline is the best in all acute and subacute cases. Of others, perhaps that most employed is silver nitrate, in doses of from 5 to 20 gr. to the ounce of water. Such a solution should not be given too high up, and if retained, which is rare, it should be followed by sodium chlorid solution to prevent absorption. It is well to use a laterally perforated tube, which should be inserted 10 inches up the rectum. The silver nitrate is best for subacute and chronic cases. Tannin is preferred by the Germans because it is non-toxic and antiparasitic, ½ per cent. solution three times a day is employed, and the patient is instructed to retain it for ten minutes.

Quinin sulphate is another favorite drug much used in irrigation. In a solution of 1:5000 it is thought to be of special benefit for the amebic form. It is given three times daily, and the strength gradually increased up to a proportion of 1:500. Of the other solutions one may mention boric acid, Condy's fluid, sulphuric acid 1:2000, perchlorid of mercury 1:5000, and of these one may inject 6 to 8 oz. and allow it to return, using in all 1 quart. Berther recommends a solution of methylene blue .2 grams to 1 litre.

Other Treatment: the Food in Dysentery.—The diet should be

very limited and non-irritating. Milk (except in the case of infants) that has been boiled may be given lukewarm, always diluted, either with non-effervescing Vichy or lime-water, or rice-water, or barley-water; 2 to $2\frac{1}{2}$ quarts should be taken in twenty-four hours where this diet is the chief one. Milk, however, is not always well borne, and it is, therefore, sometimes well to add to it a very small quantity of tea or coffee as a flavoring, or to add a small proportion of soda or else of salt. Where milk cannot be taken, broths may be safely given, or albumen-water, or various forms of mucilaginous drinks. Thin gruel is usually well borne, so also is toast-water, and in many cases raw eggs. This latter is a favorite method of feeding with the Germans. Where vomiting occurs, meat juice should be tried and barley- or rice-water.

For the thirst one may give plenty of water or orange-juice.

It is very important to give no solid food till the stools are normal for some days, and then increase very gradually. One may start a more generous diet by cereals with milk, infant foods, cocoa, egg yolk, scraped beef, toast, etc. Of the early solid foods, chicken or fish are preferred, with vegetables that are easily digested. One should avoid for a long time all indigestible foods, or those which are coarse or irritating to the mucous membrane of the bowel. All foods must be *avoided* which tend to irritate the sensitive mucosa, and one must specially prescribe foods that favor fermentation or putrefaction, also effervescing soda or Seltzer water, acid drinks, spices and alcohol, unless specially indicated; even then alcohol is probably best avoided, and one may resort to other stimulants as mentioned. Alcohol has a special tendency to increase peristalsis and cause unrest. Where patients remain ill after several weeks in spite of treatment, the diet must be increased to accord with the caloric needs of the patient. Here concentrated foods are especially indicated, such as somatose, eucasein, and similar preparations.

Serum Treatment.—It is well recognized that dysentery is a complex condition with varied causes, and in most cases bacilli or amebæ are the responsible agents. In the bacillary form various germs apparently cause the disease. Flexner classifies the dysentery bacilli chiefly in two types: (1) The Shiga type, belonging to the non-acid-forming group; and (2) the Manila variety, belonging to the acid group. This second is mainly responsible for the cases of epidemic cholera infantum.

The chief and important difference lies in the fact that the sera of patients suffering from the one form of the bacillary disease do not agglutinate with equal readiness the other varieties of dysentery bacilli; thus, for example, the bacillus of Manila (Flexner) is not always agglutinated in high dilutions by the serum of Shiga's patients. The distinction is of recent origin, and we are indebted to Martini and Lentz for a demonstration of the fact that in tests for agglutination one should use a very potent artificial serum and not the serum of patients, inasmuch as the specific agglutination is not so readily produced and the test is, therefore, more delicate.

The following facts are important in regard to a possible serum-therapy:

(1) The ingestion of cultures causes pathologic effects with the symptoms of dysentery and the production in the patient of an agglutinating serum.

(2) Furthermore, toxic effects can be produced from injection of the dead cultures.

(3) Shiga found that horses were very susceptible to the action of these dead cultures or vaccines of dysentery, and that, by injecting into horses this vaccine over a long period in increasing doses, he could obtain *immunity for the horse against fatal doses*, and in four or five months a *serum with strong agglutinative powers* for the bacillus of dysentery, and *one, too, which was both preventive and curative.* This was protective, too, not only against living cultures, but also against fatal doses of the toxins of these bacilli. He used it in 510 cases with success, reducing the death-rate by one-third. In the advanced inflammatory stage the number of stools diminished and a cure was often effected in three days.

(4) Flexner obtained an immune serum by injecting cultures of moderate virulence, and to-day he employs *various strains of the different types* for the purpose of obtaining a serum which is active against the various types of bacilli of this disease.

(5) Gay, working in Philadelphia, showed experimentally that the bacilli readily became less virulent with time, but by passage of the bacilli through guinea-pigs one could obtain a uniform virulence in the organism which was useful for obtaining uniform vaccines. The vaccine he prepared was a suspension of the bacilli killed by tricresol. This vaccine he found could protect not only against a later multiple dose of living cultures, but also produce in the horse an active immune serum which protects guinea-pigs against bacilli or against the toxins. In his experiments, he further demonstrated the effectiveness of the horse-serum, obtained from injections of one type of bacilli against cultures of other types. His illustrative table, which is highly instructive, is subjoined.[1]

TABLE VIII.—*Amount of Serum from "Flexner Horse" Necessary to Protect Against Its Own and Other Types of Bacillus Dysenteriæ.*

Weight of guinea-pig.	Amount of serum given subcutaneously twenty-four hours before.	Amount of culture given intraperitoneally.	Result.
210	None: Control.	5 oese, "Flexner."	Dead in eighteen hours.
210	0.75 cc.	6 " "	Recovered.
210	0.1 cc.	6 " "	Recovered.
210	0.05 cc.	6 " "	Dead on second day.
220	None: Control.	3 " "Shiga."	Dead in eighteen hours.
195	0.1 cc.	4 " "	Dead in twenty-four hours.
225	0.15 cc.	4 " "	Dead in twenty-four hours.
200	0.175 cc.	4 " "	Recovered.
230	None: Control.	5 " "Kruse."	Dead in eighteen hours.
220	0.1 cc.	5 " "	Recovered.
220	0.125 cc.	5 " "	Recovered.
230	0.150 cc.	5 " "	Recovered.
230	0.175 cc.	5 " "	Recovered.

[1] F. P. Gay, University of Pennsylvania Medical Bulletin, July–August, 1903.

Under the auspices of the H. K. Mulford Company, Drs. Flexner and Kinyoun have succeeded in preparing a serum likely to prove in the future of a great deal of benefit, though the published results up to the present are scarcely sufficiently abundant to demonstrate the good effects of its use.

The treatment of children with cholera infantum will be dealt with in a special chapter, and it may merely be mentioned here that the serum is regarded as useful in this form of malady as well.

Holt, in a report on the treatment by serum, found it necessary to use the serum early before serious lesions have resulted or nutrition is impaired. Repeated doses do no harm, often do good. In many of his cases, however, the patients, though apparently well of the dysentery, die later of marasmus, possibly the result of the toxins of the disintegrated bacilli. LeFetra and Howland have obtained interesting results in their study of 62 cases indiscriminately selected from dysenteric infants. In the treatment, serum was used in 10 severe cases. In 4, which were infections with the acid type, the pure Flexner serum was employed, while in 6 others, which proved to be of the alkaline or true Shiga type of infection, the serum of the Shiga horse was used; 10 to 20 cc. were injected. The results were perhaps unsatisfactory, but doubtless in part due to insufficiently early administration. In waiting for the development of cultures much valuable time is lost, and one should rather inject at once a serum in which both strains are present to obtain results. In LeFetra's series, one child was inoculated when moribund, 1 died three weeks later from marasmus, though the diarrhea was checked completely, and 4 others showed no special result.

L. Rosenthal's results with a serum from dogs, which is both bactericidal and antitoxic, is a favorable comment on its value. His cases were mostly severe, and in a majority benefit was marked in eighteen to twenty hours after treatment was commenced; 157 cases of all ages, from ten to eighty years, were treated; only 40 were examined bacteriologically, but these gave positive results. No cathartics or enemata were employed, and the diet was semisolid. The serum dosage was from 20 to 40 cc., but in severe cases as much as 140 cc. was sometimes given. When used within the first three days the effect was marked, and the malady controlled within one to two days, with alleviation of all symptoms. The mortality in all was about 4.5 per cent., while previous records of epidemics in Moscow and elsewhere gave an average always exceeding 10 per cent. Rosenthal's conclusions are in favor of the serum, especially when used early.

In cases treated early, 10 to 20 cc. of the serum should be administered every six to twelve hours; if treated later, or if the disease be of an unusually severe type, 20 to 40 cc. are used every four to eight hours. It is better to give large doses than small ones; an error on the safe side results in no danger, inasmuch as the serum is otherwise innocuous. It is administered, like the antitoxin of diphtheria, hypodermically, with the usual aseptic precautions, in any part of the body where the skin is

loose and the subcutaneous tissue abundant. The interscapular region is preferred.

While Flexner's results, and those of European observers, are still tentative, one may safely say that the administration of serum for dysentery is a rational form of treatment, that it has a distinct future, not only for cases of the epidemic tropical disease, but likewise for cases of institutional dysentery, which is now known to be caused by similar micro-organisms.

The valuable experience of Willmore among the Mussulman pilgrims at the Quarantine Station at El Tor, Sinai, is of special interest. During the year 1909 the mortality among 208 purely bacillary cases before the introduction of the serum treatment was 64.4 per cent. During the year 1910 of 72 purely bacillary cases treated with serum, the mortality was 9.7 per cent. Among the latter 5 patients died, either from causes other than dysentery, or else death occurred in less than twelve hours after the first injection of serum. Excluding these cases the death rate is then lowered to rather less than 3 per cent.

His method of treatment and details connected with the administration of the sera are best given in his own words:

"In view of the multiplicity of the causative agents usually associated with epidemics of dysentery, it is a matter of extreme importance, firstly, either to make an accurate bacteriologic diagnosis or to treat the cases indifferently with polyvalent serum. The polyvalent serum is prepared by injecting horses with increasing doses of, at first killed, and later, living cultures of twenty-four different strains of dysentery bacilli. After the last injections, all of which are given intramuscularly, in order to avoid the dangers of anaphylaxia which so often accompany intravenous injections, the horse is allowed to rest for one month before bleeding. The quantity of each individual strain and the total amount to be given at each injection is best determined by experimentation on rabbits and guinea-pigs, the amount being in inverse ratio to their virulence."

As soon as possible after admission a specimen of the stools is to be sent to the laboratory, there to be examined for amœba and sown onto plates of some differentiating medium. The latter are to be examined for colonies of dysentery bacilli at the end of twenty-four to forty-eight hours incubation at 37° C. Any suspicious-looking colony is "fished" and stabbed into mannite-litmus agar, and the diagnosis proceeded with as recommended in the paper on the etiology of dysentery by Ruffer and Willmore.[1]

At the same time about 3 cc. of blood may be withdrawn aseptically from the median basilic vein of the left arm, set aside to clot, and the serum withdrawn after twelve hours. This may then be examined macroscopically for its agglutination reactions against the main types of dysentery bacilli, and any suspicious culture isolated from the patient's own stools.

It is to be noted, that, while the agglutination test is most valuable

[1] Ruffer and Willmore, Brit. Med. Jour., September 25, 1909.

as a means toward diagnosis, it is not absolute. It proves the existence, past or present, of infection by the determining germ, when positive; when negative, however, it does not exclude the possibility of present infection. Such negative reactions are seen in two types of cases. (1) The early acute cases, when there has not elapsed a period since the onset of infection sufficient to admit of agglutinins being formed; and (2) the very severe cases, usually in old men, in which the organism is too exhausted to respond to the infection by the production of agglutinins. This point is mentioned in order to emphasize the necessity of treating all cases with either a polyvalent serum, or multiple injections of different monovalent serums.

A man may have an attack of dysentery, for instance, due to infection by Bacillus α. At any time during the course of the attack, or during convalescence, an infection by Bacillus β may be superimposed.

If seen a day or two after the onset of the second infection, the blood would give a positive agglutination reaction for Bacillus α and negative for Bacillus β; the examination of the stools would show Bacillus β to be present, while in all possibility Bacillus α would be absent, or if present, would be missed. In all cases, therefore, an examination of the stools must go hand in hand with the serum reactions in order to arrive at a true diagnosis.

It is to be noted that cases of multiple infection by amœbæ and bacilli in the same individual are by no means rare. In such cases the serum is to be administered in view of its beneficial effect on the bacillary moiety of the disease.

As regards the quantity of serum to be injected, no hard and fast rule can be laid down; as in diphtheria, each case must be judged upon its merits, and the serum pushed until its therapeutic effect is apparent and maintained. In this connection it may be noted that while the serum is more efficacious if given early in the course of the disease, it differs from antidiphtheritic serum in that it is of service in cases of one, two, three, or even more months after the onset of infection. The patients' general condition, gauged ab inspectu, is the best criterion as to the amount of serum to be given; the condition of the stools is not so important.

Speaking generally, if given subcutaneously, the serum may be administered in the following quantities, as an initial dose: 40 to 60 cc. in mild cases; 80 cc. in severe cases; and 100 to 120 cc. in desperate cases. These doses are to be repeated as required; if the serum be given intravenously, smaller doses are indicated. The beneficial effect of the serum is manifested, as a rule, in from four to twelve hours after its injection, the most striking phenomenon in all cases being the improvement in the patient's general condition, as indicated by pulse, heart sounds and temperature. With this striking change in the patient's general condition, there may be no corresponding improvement in the character of the stools, which remain, in some cases, particularly in those of the gangrenous type, more abundant and fœtid, and contain more sloughs than before, though the number passed is usually dimin-

ished. This curious combination of general Euphoria with gangrenous stools, may persist for three or four days.

The untoward effects of the serum are usually of rare occurrence and trifling importance, the phenomena of the so-called serum disease being in our experience characteristic by their absence. Fairly frequently a rise of temperature may be observed, usually about six hours after the injection of serum; it is usually insignificant and requires no special treatment.

Surgical Measures.—These have been used in unfavorable acute cases as well as those chronic cases which are quite unresponsive to medical treatment in any form. Patients with acute dysenteric ulceration, running a downward course, have been subjected to operation (colostomy) with a view to giving the intestine rest and thus permit healing to occur, and, further, to enable complete irrigation of the large bowel with various suitable solutions. The bowel is opened above the site of inflammation, sometimes in the lower end of the ileum; at other times, and more frequently, in the ascending colon just beyond the cecum. Cheyne and Burghard record satisfactory results.

Relief was obtained in some instances even before the bowel was opened, the mere bringing of the intestine out of the wound sufficing to stop diarrhea and tenesmus, even when the operation was left at this stage for several days, and the loop of bowel kept thus unopened at the abdominal incision.

It is for chronic cases, however, especially that operation on the colon (colostomy or colotomy) has given good results in isolated instances. Ulcerations heal more readily when an artificial anus has been created above the site of disease, and then the operation wound may be closed when the bowel has become well again. Irrigation is carried on as above.

Appendicostomy has also been tried, with irrigation of the bowel through the appendix opening, but not with satisfying results.

TREATMENT OF THE AMEBIC TYPE

Prophylaxis here concerns an infection which is less virulent, and, although the life history of the parasite is not understood, one may reasonably conclude that it is wise to care for the water supply, to disinfect the feces, and to avoid the contamination of food stuffs from suspected water or from uncleanliness through contact with patients affected.

Rest in bed is as essential here as in the bacillary form, but there is some difficulty in carrying this out in the more chronic forms of the disease. Certainly, it has been acknowledged that general improvement succeeds the maintenance of the recumbent posture, while exercise is accompanied by exacerbation of the symptoms. The rules of hygiene, as laid down for the bacillary type, hold equally well here. So far as the diet is concerned, a somewhat more liberal supply of food may be allowed in the more chronic forms, semisolid, non-irritating foods being permitted (milk-toast, soft-boiled eggs, etc.), but the restriction of quantity is im-

portant. No specific treatment is known, and no serum has been found to be beneficial in this variety of the disease. Local applications are useful here as in the bacillary form.

Medicinal Agents.—It may be said that no drugs have proved themselves of special value. Many have used calomel in minute doses frequently throughout the day, and claim good results. Others say the same for salol and various antiseptics, while with others again the tinctura monsonia ovata has acted well. No drugs, however, can claim special attention, and the local treatment by irrigation has been received with more popularity.

Ipecac is of late years attracting increased attention, and by some is regarded almost as a specific. The method of its use is important. After an initial purgation with castor oil, the ipecac in pill form and coated thickly with salol, is administered in doses of 40 to 60 gr. in the evening. On each subsequent evening the dose is reduced by 5 gr. till the limit of 10 gr. is reached, and this dose is maintained for two weeks.

The stools become diarrheic and soft, and the amebæ disappear almost immediately. Irrigation may be simultaneously employed, but from its mechanical cleansing effects only and not because of any direct action on the bowel or its contents.

With ipecac it is claimed that surgical intervention becomes unnecessary. At all events the surgical treatment of the bowel itself in these cases has not been productive of satisfactory results.

Irrigation.—This method is the most rational if one could be certain of obtaining direct action upon the amebæ. The amebæ are easily affected by antiseptics, they are more easily acted upon in this way, and the results have sometimes given great satisfaction. Quinin, as used for the chronic bacillary forms, is most commendable, and the irrigation methods are identical. Daily injections should be persisted in till the amebæ have disappeared from the feces.

Surgical Treatment.—Murray has treated chronic cases of amebic dysentery by forming a complete artificial anus through an inguinal colostomy (right side), and was enabled to get marked improvement in the gravely affected colon.

COMPLICATIONS

The complications require special attention. *Abscess of the liver* is the most common, and is usually accompanied by fever, chills, sweating, local pain, enlargement of the liver, edema of the overlying skin, etc. The abscesses may be single or multiple. Spontaneous recovery of a single abscess occurs and rupture may take place into the colon. The result is usually favorable. Multiple abscesses scarcely ever recover, and the treatment is purely symptomatic. For single abscesses early surgical interference with drainage is the wisest procedure. Exploratory puncture, if successful, should be at once followed by free opening to avoid further spread of infection. Additional treatment is mainly symptomatic and supporting.

Abscess of the lung sometimes follows hepatic abscess, and for this complication, too, operation is the best means to obtain rapid success. Opening of the abscess, after removal of a portion of a rib and drainage, often give excellent results. In addition, one may recommend deodorant inhalations or mild antiseptics as well as good nourishing food.

Perforation of the intestines is, as a rule, not amenable to treatment, as the lesions are so extensive around the perforation as to render all measures devoid of benefit. Where the perforation is walled off by local inflammation a fatal result is, at all events, delayed.

Hemorrhages and *peritonitis* (local) sometimes occur. The treatment is purely symptomatic. For the former, injections of adrenalin chlorid, in great dilution, may be beneficial, and the use of opiates to allay peristalsis and quiet the circulation. Otherwise, symptomatic treatment is all that can be suggested.

LEPROSY

By Isadore Dyer, Ph. B., M. D.

Leprosy is a contagious disease, due to the acceptance of the lepra bacillus by the various organs of the body, more particularly the skin, nerve apparatus, and the lymphatics. Depending upon the degree of bacillary occupation there are various evidences of the disease. These are the direct manifestation of the presence of the bacilli and their products, and of the alterations in the several tissues affected as the result of this; besides, there are distinct constitutional symptoms which are associated with the development of the disease before and during the existence of local manifestations.

While leprosy has been variously described in ecclesiastic and other literature since the earliest times, its particular study has become exact only since the discovery of the *Bacillus leprœ* by Hansen in 1878.[1] Neisser confirmed this discovery in 1879.[2] A large number of observers (Cornil, Thoma, Hillairet, Hillis, Kobner, Atkinson, Koch, Unna, Thin, Byron, Galatz, Arning, etc.) have since conclusively demonstrated the presence of the bacillus as identified with leprous processes.

Leprosy exists in all parts of the world. It is endemic in the East (China, estimated, 2,000,000; Japan, 20,000; India, 200,000; Philippines, 5000, etc.), Africa, Madagascar, Arabia, Persia, Russia, Norway and Sweden, Islands of the Pacific and Indian oceans. It is also endemic in Central and South America, Mexico, West Indies, Hawaiian Islands, Australia, and New Zealand. It is prevalent, but under control in Canada. It is endemic in Louisiana, and probably so in California and New York; the disease also occurs in many other states.

Leprosy probably begins with the introduction of the bacillus through the nose or mouth. Goldschmidt, Sticker, Morrow, and others have claimed this as the probable avenue of infection. No initial lesion has yet been determined, though early evidences are found in the nose, pharynx, and throat, and a leprous ulceration on the nasal septum is usually the first sign of the disease.

The incubation period of leprosy is not known. Some cases develop rapidly in a few weeks, and others require months or years to reach the same grade of the disease.

Various theories have been evolved regarding the etiology of leprosy, but it seems to be simply a question of individual susceptibility in the

[1] Quarterly Jour. Microscop. Science, London, 1880, N. S. xx, 92–102; Virchow's Archiv., 1880, Bd. 79, p. 31.

[2] Breslauer Artzl. Zeitsch., 179, Nos. 20, 21; Virchow's Archiv., Bd. 84, p. 514.

presence of a contagium. The burden of proof rests with those who claim fish, salt meat, or other diet as responsible.

Leprosy has spread wherever it has been introduced; where community life, hygienic environment, and the individual standard of metabolism is high, the disease does not spread rapidly.

Leprosy, like other bacillary and infectious diseases, is self-limited. With various conditions and symptoms, lasting over months or years, the disease may present as the final evidence of the spent value in force only a few scars on the extremities. The disease will have periods of recurrence and abeyance, years intervening between the manifestations. Its closest congeners are syphilis and tuberculosis, both of which are, as well, self-limited. The evidences in leprosy are directly due to the presence of the lepra bacillus, either colonizing in the skin and presenting characteristic lesions of macules or tubercles, or else various nerve alterations and evidences are occasioned by leprous masses accumulated in the sheaths of the larger nerve trunks. Often both skin and nerves are simultaneously involved. Now and then, with the attack of a new region by the bacilli, a characteristic leprosy exanthem appears, associated always with a fever, called "lepra fever." The lesions are usually papules or tubercles, which fade shortly after the fever subsides.

Leprosy is classic in its manifestations on the skin; its selection of the face (nose, *alæ nasi*, lips, and chin), ears, the hands, forearms, the buttocks, legs, and feet; the symmetry of the lesions, the color of dusky red which is *sui generis*, the anesthesia which is accentuated where the pigment is deepest—all make the differential diagnosis easy. The tubercle of leprosy is either the size of a pea, when it is quite numerous and almost fibrous in consistency and even waxy in hue, or it is the size of a small marble, when it is deep seated, rounded, typic in its red-brown color, which is made more prominent by the telangiectatic vessels running over the lesion.

The tubercles are grouped, but irregularly. The processes of the disease are slow, and, even though the bacillus is malignant in its propensities, destructive lesions are unusual, except late in the disease or else in trophic nerve types.

Leprosy is full of chances for its victim. Its evidences frequently disappear and may not come again, or may stay away for months or years. This further argues a parallel of self-limitation, as with syphilis and tuberculosis, both of which diseases may get well spontaneously.

There are certain determining points in the recognition of leprosy which may always be considered as characteristic in the several types:

(1) Habitat, whether in infected community or household.

(2) History of exposure to known case of disease.

(3) Anesthesia (usually analgesia only) in lesions.

(4) Trophic disturbances, such as eruptions of bullæ on fingers, toes, hands, and feet, perforating ulcers of hand or feet, muscle atrophy, mutilating ulcers at articulations of phalanges of fingers and toes; ectropion; clubbed fingers; paronychia.

(5) The "claw hand."

(6) Discolored and blunted nails.

(7) Characteristic anesthesia and contraction of little finger, an early sign.

(8) Loss of expression in face, satyriasis; or later, leontiasis; the hunted, anxious look.

(9) Leathery ears.

(10) The peculiar speech, raucous in note.

(11) The finding of the lepra bacillus, especially in tubercles, scrapings of skin, and in nasal secretions.

With leprosy many methods of treatment have been essayed, mostly empirically. The analysis of the treatment of leprosy practised in civilized times resolves these into the following: (1) Sanitary; (2) hygienic; (3) supportive or tonic; (4) alterative; (5) empiric; (6) serum; (7) surgical.

The **sanitary treatment** of leprosy has been practised at intervals since Biblical times, and has consisted in the segregation of those afflicted under varying conditions of care or lack of it. In Norway, India, the Hawaiian Islands, the Philippines, Japan, and among some of the British, Danish, and Dutch colonies, colonization has been practised, and a high degree of humanitarian direction has obtained. In many countries the care of leprosy depends solely upon the charity and disinterestedness of religious devotion.

The **hygienic treatment** of leprosy has gradually evolved from the sanitary disposition of the disease. Personal régime, directed at individual utensils, habitations, with direct regard for the care of the person affected with the disease; bathing, healthy surroundings, and wholesome diet, regulated only so far as quality is concerned as regards the individual himself.

Particular treatment has depended on the viewpoint of the particular observer.

Supportive or **tonic treatment** has been essayed with hoangnan, strychnin, arsenic, the mercurials combined with iron or other tonics, *pro re nata.*

Alterative treatment has been carried out with salicylate of soda, salol, bichlorid of mercury (Crocker), europhen (Goldschmidt), chlorate of potash (Chisholm, Carreau).

Empiric treatment has been employed in almost every leper center. India has added most to the drugs supplied to this end, and there may be mentioned the *Anacardium occidentale, Gynometra ramiflora, Dipterocarpus turbinatus, Gynocardia odorata, Hydrocarpus Wightoni, Hydrocarpus venenata, Poregania glabra, Psoralea coryfolia, Semeacarpus anacardium, Arachis hypogœa, Cassuvium pomiferum* Lamk.

Of these, chaulmoogra oil, expressed from *Gynocardia odorata* or the *Hydrocarpus odoratus,* has alone survived in especial usefulness.

Chaulmoogra oil is administered in various ways, depending upon the adaptability of the patient's stomach and the method followed by the person employing it. This oil is derived from various sources, but

that which is employed in the Sandwich Islands, at the Havana Hospital, and in the Louisiana Leper Home is prepared from the fresh seeds of the *Gynocardia odorata*, and should be employed in as crude a state as it can be obtained. The dosage of the oil itself should be begun small, say 3 or 5 drops. This should be increased by adding 1 or 2 drops at intervals of three to five days, gradually accustoming the stomach to the increased dosage. In this way a maximum of 120 to 150 drops at a dose may be attained. The oil is best given before meals, and can be taken in capsules, milk of magnesia, coffee, or with aromatic cordials, such as anisette. Unna gives the oil in pills made with domestic soap, and in Guadalupe the chaulmoogra oil is combined with arsenic, nux vomica, and ferruginous tonics. Some use the gynocardic acid instead of the oil, but the writer has found little or no result to follow the use of the essential or fat acids derived from the oil. Most patients are able to take large doses as soon as they have become accustomed to the aromatic odor of the remedy. The majority of cases treated with chaulmoogra oil in Louisiana have improved under its use, and a number of cases have entirely recovered from the disease.

More recently, *Assacou*, or *Assacon* (*Hura brasiliensis Martin*), of the family of the *Euphorbiaceæ* and *Tua Tua*, have been suggested in the West Indies, Brazil, and Venezuela respectively.

The powdered bark of the red mangrove, or mangle, used in pill or tincture, has been used at Key West and in Havana. Unna has employed ichthyol extensively and with results.

The mixed toxins of erysipelas, the virus of small-pox and vaccination have each been tried.

Serum Treatment.—Tuberculin has had several experimenters.

Of special serums, those of Carrasquilla, of Bogota, U. S. of Columbia, and of Laverde, both derived from animal inoculation, may be mentioned. E. R. Rost, of the Indian Medical Service, used a serum which he calls "leprolin," derived from a toxin of the cultivation of the bacillus lepræ.

Rost, in preparing his serum, compared the action of tubercle bacilli in certain media, and finally used distilled beer extract, nutrient agar, and dialyzed fish broth. In these the bacillus lepræ grew rapidly, over 300 cultivations having been made. Cultivations of leprosy in the beef extract were allowed to grow at a temperature of 37° C. for six weeks, then sterilized, and passed through a Pasteur filter, when glycerin was added to the clear fluid.

The dose is equivalent to 5 cc. of pure culture of the bacillus of leprosy. Injections of leprolin of 10 cc. are made with sterile syringes into the muscles of the buttocks or of the arm. There may be a reaction for two or three days, during which time the patient should be kept in bed and laxatives should be given. Injections are repeated at intervals of ten to fourteen days, according to the case. In conjunction with this, equal parts of salt and vaselin are applied to anesthetic areas and to ulcers, and an ounce of salt is taken with the meals every day.

Leprolin is contra-indicated where there are complications, such as pulmonary tuberculosis or albuminuria.

Rost reported several cures, and a decided amelioration in almost every case in which the injections were used.

In 1897 the writer reported 5 cases treated with the antivenomous serum of Calmette. The detail of the method employed is related in the report made to the Berlin Lepra Conference in 1897. Two of these cases recovered, and in other cases afterward injected marked amelioration resulted. A noteworthy fact in connection with this treatment was that, whenever injections were made in lepra tubercles, these underwent resolution in a day or two.

Owing to the difficulty in obtaining this serum in quantity, normal horse serum was employed in a series of 6 cases for a period of nearly eight months. Varying doses were injected, but no results were obtained.

The **surgical treatment** of leprosy must be directed at the removal of tubercles by caustics, cautery, excision, and the stretching of nerve trunks involved in leprous change; the operative treatment of leprous ulcers, mutilations, etc., is indicated by the presenting condition.

Electricity applied in trophic types is not only indicated, but may be demanded at times; *x*-ray exposures have as yet yielded only amelioration.

With leprosy results can only be obtained when the individual case is treated on its own merits. After several years' experience with the disease, the writer concludes that leprosy can be controlled, arrested, and even cured in cases amenable to treatment. Since 1894 complete eradication of the disease in 16 cases has been accomplished in Louisiana. Certain observations have been derived from these experiences:

(1) In every case full diet was allowed and no restriction directed, excepting of naturally indigestible foods. The disease in nowise seems to be affected by any particular articles of food.

(2) Community life affects the disease only so far as probability of contagion is increased. Race seems to have no bearing, and only particular races suffer because of their family contiguity.

(3) Baths are essential in the treatment of leprosy. Hot baths are of much more service than topical treatment.

(4) Complicating conditions or diseases must be guarded against, as the lepra subject is readily susceptible to infectious fevers, pneumonia, diarrheas, and kidney involvement.

(5) Tonics, such as strychnin, phosphorus in combination, and arsenic are always indicated. Every patient should be given strychnin continuously.

(6) Continue treatment, at intervals, for years after the evidences are gone, as a precautionary measure.

(7) The remedies, employed regularly and otherwise over a period of sixteen years in the treatment of leprosy in over 200 cases, embrace the following: ichthyol, salicylate of soda, arsenic, bichlorid of mercury, chlorate of potash, chaulmoogra oil, antivenomous serum, normal

horse serum, red mangrove bark, and the derivative fat acids, etc., of chaulmoogra oil.

A survey of the history of the treatment of leprosy would indicate that the disease is one of high catabolism, being rapid or slow according to the individual resistance of the patient. Wherever a case of leprosy has been reported cured it has been evident that the results obtained bore upon this point. Persistence in treatment and a careful attention to the requirements of the individual patient have always raised the tone of the patient, and in some places have successfully arrested the disease. Every year more cases of leprosy are reported as cured, and the intelligence of leprologists the world over is more satisfied with the possibilities of relief for this condition. The disease is no longer neglected and the hope of a specific is yet within the possibilities.

TYPHUS FEVER

By John F. Anderson, M. D.

Typhus fever is an acute infectious disease, characterized clinically by a sudden onset, usually with a chill, severe headache, marked nervous symptoms, a macular eruption, frequently becoming petechial, and terminating by crisis. The disease is conveyed by the bite of the body-louse, *Pediculus vestimenti.*

Typhus fever is also known as spotted fever, exanthematic typhus, jail fever, ship fever, tabardillo, etc.

It is essentially a disease of temperate and cold climates; it probably never prevails in the tropics except at considerable altitudes. This disease was formerly one of the great epidemic diseases of temperate climates, but in late years has almost disappeared, lingering only in places where sanitary conditions have not kept pace with modern progress.

The disease is endemic in the mountains of northern Africa, portions of Russia and southeastern Europe, portions of Ireland, northern England, certain parts of Asia, and in America, on the Mexican plateau extending down into Central America. In Mexico and Central America the disease does not prevail at a lower altitude than 1500 meters.

It is only in the light of recent advances in our knowledge of the etiology of typhus that an understanding has been had of many facts that have been noted regarding the distribution and spread of the disease.

Typhus has been considered one of the most contagious diseases, but the contagion appeared to have a decided short "striking" distance; for example, when a case was in the ward of a hospital, new cases might appear in adjoining beds on the same side of the ward, but almost never across the aisle. Again, it has been noted that physicians and nurses on attendance of cases of typhus were very liable to be attacked, and the closer their association with cases, the greater the chances of infection.

Up to 1909 all attempts to produce the disease in lower animals had been unsuccessful. In the summer and fall of that year Nicolle, Comte and Conseil, working in northern Africa; Anderson and Goldberger, and Ricketts and Wilder, working in Mexico, reported their work on the successful inoculation of monkeys with the disease. Nicolle and his co-workers were unable to produce the disease by the direct inoculation of the lower monkeys with blood from human cases, but did succeed when the infection was first passed through the chimpanzee.

On the other hand, Anderson and Goldberger had no difficulty in producing the disease in Mexico in both the Rhesus and Capuchin monkeys by the inoculation of blood from human cases.

All these workers were impressed with the idea of an insect being the means by which the disease was transmitted, and the epidemiological data pointed strongly to the body-louse. It was found by them that typhus fever could be produced in monkeys by allowing lice to bite them after having fed on cases of typhus either in man or monkeys. This important advance in our knowledge of the means of transmission of typhus explains many obscure points in regard to the spread of the disease, and provides us with the knowledge necessary for its successful prevention and eradication.

PROPHYLAXIS

Now that we know how the disease is spread, measures may be intelligently applied for its prevention. The body-louse, *Pediculus vestimenti*, being almost certainly an essential factor in the transmission of the disease, our efforts should be concentrated on the destruction of this insect. An important part of these efforts is the destruction of unsanitary dwellings and improvement of the living conditions of the poor. The louse is an insect that loves best to dwell with those who live in squalor and are of filthy habits, so that an improvement of the living conditions of the poor will result in a decrease in the prevalence of the insect.

When a case of typhus is discovered, the patient's clothes should be removed and immediately placed in boiling water or a 1:500 solution of bichloride of mercury for the destruction of lice. The patient's hair should be clipped, and he should be given a thorough sponging with a 1:2000 solution of bichloride of mercury, which will destroy the eggs of the louse. After the removal of the patient from the room, the apartment should be thoroughly fumigated by the burning of sulphur in the proportion of 5 pounds of the sticks or flowers to each 1000 cubic feet, and the room kept sealed for at least twelve hours. The use of liquid disinfectants or of formaldehyd for the destruction of the lice in the room is of doubtful value. If the fact is kept in mind that the louse is necessary for the spread of typhus fever, just as the mosquito is for yellow fever, the prophylaxis of the disease is greatly simplified and the discomfort of the patient and family much decreased.

TREATMENT

There is no specific treatment for the disease, though there is hope that the recent experimental work may result in progress along this line. The disease is best treated by attention to the diet during all stages, treatment of the fever and nervous manifestations, and of the special complications which very frequently occur. On account of the severity of the onset, there is rarely trouble about the patient not

wanting to go to bed; but absolute rest in bed should be insisted on until at least one week after disappearance of the fever.

The sick-room should be well ventilated, light, and airy. The windows should be provided with bars, as I have known patients while delirious to escape. The treatment of patients in the open air in tents, as recommended by many writers, seems to be of distinct value.

The diet should be as full as it is possible for the patient to take. During the stage of onset the diet should be exclusively liquids. It will be found that many patients are unable to take milk, but when it is well borne, it should always be given. If milk is not well taken, broth or soups, particularly vegetable broths, such as pea, bean, or rice, should be given. Most typhus patients take eggs without trouble, and as many as two to four may be given in twenty-four hours. They may be taken in the soups or even soft boiled or as eggnog.

As soon as the patient expresses a desire for food or his mental condition will allow, he may be given solid food, in the form of toasted crackers or bread, chicken, lamb-chops, or rare beef. After the temperature has reached normal, the diet may be rapidly increased, with the exception of articles of food difficult of digestion.

For the reduction of fever there is nothing that will take the place of baths, preferably the full tub-bath, as used in typhoid fever. When the temperature is not very high, sponge-baths may be used. An ice-cap to the head is sometimes grateful to the patient for the relief of the intense headache and to allay nervousness.

Among the special symptoms that require treatment are failure of the heart; when the pulse remains over 100 or there is much cyanosis, strychnin sulphate or digitalis or both should be given every four hours. Some writers think well of alcohol, either in the form of brandy or some of the light wines. The severe headache is treated by the ice-cap; if very severe, small doses of morphin or codein. For the insomnia it is sometimes necessary to give trional. Attention must constantly be given to the nose, nasopharynx, larynx, and ears. The nose, mouth, and throat should be frequently washed out with some mild antiseptic wash, and the ears should be examined daily. Involvement of the upper respiratory passages is one of the most frequent and serious complications of typhus fever.

When the crisis occurs, the patient is often profoundly prostrated and is bathed in a profuse sweat. When this condition is present, small doses of atropin hypodermically should be given every four hours until the sweating has ceased.

TROPICAL DISEASES

By M. J. Rosenau, M. D., and John F. Anderson, M. D.

MALARIA

Malaria is a communicable infection invariably associated with a protozoan parasite, first described by Laveran[1] in 1880. The cause of the disease is transmitted to man by the bites of certain mosquitoes. Malaria includes a group of diseases exhibiting a great variety of manifestations, characterized by febrile paroxysms, a tendency to periodicity, anemia, enlargement of the spleen, and a deposit of black pigment (melanin) in the viscera and elsewhere. The term is from the Italian *mal' aria*, meaning "bad air," and calls to mind the notion which formerly prevailed that the malady was due to a miasm or noxious emanation contaminating the air.

The parasites causing human malaria are minute unicellular animal organisms, which pass through a long and complicated series of changes to complete their life cycles. They are classed with the *Sporozoa*, order *Hæmocytozoa*, genus *Plasmodium*. The parasite passes the sexual phase of its life cycle in the body of the mosquito. This insect must, therefore, be regarded as its definite host. Only the non-sexual phase of its existence is found in man, who is, therefore, the intermediate host of the parasite.

The malarial diseases are known by many other names, chief of which are intermittent fever, remittent fever, ague, chills and fever, pernicious fever, pernicioso, paludism, marsh or swamp fever, hemamebiasis (Ross), Wechselfieber.

The malarial infection is second only to tuberculosis in the great range of its geographic distribution. It prevails both as epidemics and in endemic foci on every continent of the globe. The incidence to the disease varies greatly in different countries. While the infection may be introduced into a locality where it may remain endemic, on the

[1] Laveran made his notable discovery of the malarial parasite on November 6, 1880, and communicated the fact to the Academy of Medicine, Paris, November 23, and again on December 28, 1880, as follows: Note sur un nouveau parasite trouvé dans le sang de plusieur maladies atteints de fièvre palustre, Acad. de med., Paris, Nov. 23, 1880; Deuxième note, Ibid., Dec. 28, 1880; Nature parasitaire des accidents de l'impaludisme, Paris, 1881. Laveran made his discovery with dry lenses while studying the pigment found in the blood of malarial patients. On account of the flagellar forms seen by him, he believed he was dealing with an organism belonging to the genus *Oscillaria* and proposed the name *Oscillaria malariæ*.

other hand, places once badly infected are now free of the disease.[1] In the popular mind a place is considered healthful or not depending upon the prevalence of malaria. The disease is known in such cold countries as Sweden and Finland. It exists in many places throughout the temperate zones, but as the equator is approached the infection increases markedly in prevalence and virulence.

The association between malaria and swamps has long been known and is now explained by the mosquito theory. The relation of season to the disease varies in different latitudes, depending upon the rainfall, temperature, and other factors which favor the development of the mosquito. In cold countries the infection is rife during the summer months when the sustained average temperature is at least 60° F., which is necessary for the completion of the extracorporeal phase of the life cycle of the parasite. In Italy the severe infections prevail during the late summer and autumn; hence, the name estivo-autumnal malaria. Formerly much consideration was given to the influence of altitude, moisture, rainfall, winds, decomposing vegetable matter, and other influences which are known to have more or less effect upon the development and activity of the *Anopheles* mosquito. All ages and both sexes are liable to the infection if exposed.

Immunity to malarial infection is not known in the sense of immunity to small-pox or yellow fever. In fact, persons once infected are liable to relapse, and if exposed to reinfection may suffer from many attacks until the disease finally becomes chronic, but some persons born in malarial regions, especially negroes and other dark-skinned races, attain a certain amount of tolerance or immunity by reason of repeated infections when very young. Children who survive these early attacks frequently carry the parasites in their blood for many years. The parasites gradually disappear, leaving them resistant to the disease. These important observations have been established by Koch,[2] who points out how the disease is kept alive and disseminated by these individuals, who go about in apparently good health and free from fever, but with many parasites in their blood. They have acquired, perhaps partly inherited, an immunity against the malarial toxin, but not against the malarial parasite, and, therefore, remain a menace to others. In many respects such persons resemble bacillus carriers.

The Parasite.—There are at least three distinct species of the genus *Plasmodium* recognized in man. Each species remains distinct, cannot be changed into the other, and each one produces a distinct clinical type of the disease. So that in one sense we have three closely allied diseases to deal with:

Plasmodium malariæ (Laveran, 1880) is the cause of quartan malarial fever.

[1] Holland, England, and our own New England States are examples of districts from which the disease has practically disappeared. The islands of Mauritius, Reunion, numerous places in North America and Chile, and, to a lesser degree, Sweden are examples of countries in which malaria has recently made new conquests.

[2] R. Koch, Die malaria in Deutsch Ostafrika, Arbeit. d. kais. gesundh., 14, 1898, p. 311.

Plasmodium vivax (Grassi and Feleti, 1890) is the cause of tertian malarial fever.

Plasmodium falsiparum (Welch, 1897) or *Plasmodium immaculatum* (Grassi) (Schaudinn, 1902) is the cause of estivo-autumnal malaria or tropical malaria.

In a brief consideration of the life cycle of the malarial parasite we must consider—

(1) The phase of its development in man.

(2) The phases of its development in the mosquito.

(3) The latent or dormant phase.

(1) In man the malarial parasites pass through the non-sexual phase of their life cycle. The mosquito inoculates the spores (*sporozoites*) beneath the skin. These mintue motile parasites gain entrance to the blood stream, enter the red blood-corpuscles, in which they develop into ameboid nucleated parasites, growing at the expense of the red cell. It is important to note that the growing parasite uses the hemoglobin of the red corpuscle as food, converting it into a pale protoplasmic material constituting the mass of the organism, leaving as residue a black pigment known as melanin. In one, two, or three days, depending upon the species, the sporulating forms develop. A number of daughter cells are formed, arranged in a cluster or roset around a central mass of pigment. The red globule breaks, liberating these daughter cells and also a poison or toxin, which causes the malarial paroxysm. The free daughter cells, now called spores (sporozoites), re-enter other red globules to repeat the sporulating cycle.

(2) The mosquito drinks the blood of a man infected with the malarial parasite. In the stomach of the mosquito the microgamete (male) and the macrogamete (female) unite to form a vermicule. This newly developed phase in the life history of the parasite is actively motile and penetrates the stomach wall of the insect, and finds lodgment in the muscular fibers which form the delicate outer layer of the mosquito's stomach. Here the parasite passes through an exceedingly interesting phase of its wonderful life cycle. The vermicule develops into a well-formed sac or zygote containing many spores (merozoites) arranged in bundles. These zygotes attain considerable size and are plainly visible protruding from the stomach wall of the insect, forming little tumors under the outer coat. When the zygote is ripe the sac breaks, liberating the spores, which travel into the venosalivary gland of the insect and from there are introduced into the system of man, when the insect stings its victim.

(3) The dormant or latent phase in the evolution of the malarial parasite is supposed to exist from circumstantial evidence alone. This phase is of very great interest to the physician from the standpoint of treatment, and gives us the only clue we have to account for the recrudescence of the disease after the lapse of months or years. We now have a biologic explanation of the dormant phase of malaria. According to Schaudinn it is the macrogamete which lies dormant or latent for long periods. Under certain conditions this macrogamete may by parthe-

nogenesis start a new brood of schizonts; that is, start a new cycle of asexual sporogeny.

Other sporozoa, bearing a close zoölogic affinity to the malarial parasite of man, are known to infect many of the lower animals—mammals, fishes, mollusks, etc. Up to the present time no other animal than man and mosquito is known to harbor the parasite of human malaria. There is some reason to believe, however, that there is such an animal, and that the animal when discovered will likely be found to be one inhabiting the swamps and marshes. The fact that the disease is said to exist in the absence of man is very suggestive of the possibility of another extracorporeal phase than the one found in the mosquito.

The important features regarding the three different species of plasmodium which have a bearing upon the treatment of malaria may be summed up as follows:

The quartan parasite (*Plasmodium malariæ*) was the one originally discovered by Laveran in 1880. All the phases of its life cycle may be observed in the peripheral blood, and it is, therefore, a favorite organism for beginners to study, especially as it has large blocks of pigment which are comparatively readily found under the microscope. The pigment does not vibrate as actively, nor is the young form as actively ameboid as the tertian variety. The roset has from six to twelve spores. The infected red blood-corpuscles do not become discolored and do not become altered in size. The quartan parasite, when full grown, may be as large as the corpuscle containing it. The quartan parasite requires seventy-two hours to complete its life cycle in the blood, causing a paroxysm every fourth day. This form is readily influenced by quinin, but the liability to reappearance of the plasmodium in the circulating blood and recrudescence of the symptoms after leaving an infected region persists for a long time.

The tertian parasite (*Plasmodium vivax*), also known as the benign tertian, requires forty-eight hours to complete its life cycle in the blood. It is the most actively ameboid of all the malarial parasites, and usually has fine granules of pigment which may seem to be in active swarming and vibrating motion. This is the form of the malarial parasite which causes an enlargement of the red blood-corpuscles containing it. The cell becomes swollen, pale, and often the seat of a peculiar granular degeneration. The tertian parasite may grow as large as or even larger than the normal red corpuscle. The maturating form is a roset containing fifteen to twenty spores. All the forms may be seen in the circulating blood, but the segmenting forms are more numerous in the capillaries of the viscera. The benign tertian is also readily influenced by quinin, but the liability to relapse persists for a long period.

The tropical parasite (*Plasmodium falsiparum*), also known as the estivo-autumnal, usually occurs in the peripheral blood in great numbers. There are believed to be several varieties of this species of malarial parasite, one pigmented, the others non-pigmented; one requires twenty-four hours to complete the life cycle and is known as quotidian, another requires forty-eight hours to complete its life cycle and is known

as subtertian or malignant tertian. The gametocytes of all the forms of tropical malaria are crescent bodies, which distinguishes it from all other species. The form of the parasite found in the circulating blood is commonly a small ameboid parasite which rapidly assumes a signet-ring form in shed blood. The segmenting forms are not often seen in the peripheral blood, but may be found in great numbers in the internal organs. The rosets contain usually six to eight spores. The infected red corpuscle is often shrunken and copper colored or completely decolorized, never enlarged, as in tertian. Quinin has less influence upon this species of the malarial parasite than upon the other species just described. It has absolutely no action upon the crescent bodies, and while it often causes a rapid disappearance of the ameboid forms from the circulating blood, it seems to have little effect upon the segmenting forms in the capillaries of the internal organs.

The Mosquito.—The mosquitoes concerned in the transmission of human malaria belong to the subfamily *Anophelinæ*, and were all formerly comprised in the genus *Anopheles* until this genus was subdivided by Theobold into twelve new genera, basing his classification upon variations in scale characters. There are almost one hunderd described species of the *Anophelinæ*, sixteen of which have been implicated as the definitive host of the malarial parasite.

The malarial mosquitoes may be distinguished by the following characteristics: The palpi are as long as the proboscis in the females. In the yellow fever mosquito (*Stegomyia calopus*) and the common *Culex* mosquitoes the palpi are quite short in the female. The position which the malarial mosquitoes assume when resting upon a surface is somewhat characteristic; the proboscis is almost in a straight line with the body, whereas in the common *Culex* and *Stegomyia* mosquitoes the proboscis forms a distinct angle. This gives the malarial mosquito its characteristic attitude, which is described as "awl-like," whereas the yellow fever and common *Culex* mosquitoes appear "humpbacked"; this is due to differences in the angle which the proboscis makes to the line of the body. The *Anophelinæ* or malarial mosquitoes are, for the most part, medium-sized brownish insects, having, as a rule, spotted wings.

The malarial mosquito is not a domestic insect. It breeds by preference in the natural collections of water in the woods, fields, and swamps, which explains the appearance of the disease in such regions and accounts for its disappearance from well-paved and drained cities and well-cultivated lands. The *Anophelinæ* are nocturnal in their habits and are rarely active during the daytime or in bright light. It is very important, therefore, to remember that the danger from the sting of the malarial mosquito is at night, especially shortly after sundown and shortly before sunrise.

Classification.—The present state of our knowledge does not permit of a scientific classification based upon the parasitology. The following arrangement, based upon the dominant clinical manifestations, will best suit the purposes of treatment:

(1) Intermittent malarial fevers.
(2) Remittent, continued, and irregular malarial fevers.
(3) Pernicious attacks.
(4) Malarial anemia or cachexia (chronic malaria).
(5) Latent or larval forms.
(6) Relapses.

The intermittent fevers are usually caused by the tertian or quartan parasite. The tropical variety or estivo-autumnal may cause quotidian paroxysms with intervals of apyrexia, but only when uninfluenced by quinin, in early and simple infections. These cases are usually of the remittent type or cause continued fever. It is the latter infection which is especially liable to develop pernicious or malignant forms, assuming algid, choleraic, comatose, etc., types.

The successful treatment of malaria rests upon an accurate diagnosis, and this can be established in many cases only by a microscopic examination of the blood.

In malarious regions the nature of many cases of intermittent fever may be recognized clinically by the periodicity, enlargement of the spleen, and response to quinin. Reliance upon periodicity as a diagnostic sign not uncommonly causes confusion with tuberculosis, pyelitis, and liver abscess. Valuable time will be lost in the treatment of many cases of remittent tropical and pernicious malarial fevers without the use of the microscope as an aid to diagnosis, for they are often mistaken for typhoid fever, yellow fever, or other affections.

In badly infected malarious regions many patients are carried to the hospitals with symptoms of cerebral apoplexy, coma, uremia, dysentery, etc., due to a concentration of the malarial parasite in the capillaries of the brain or other internal vital organs. In the peripheral blood of these cases will usually be found large numbers of the small signet-ring parasites of the tropical form of malaria. Without treatment these cases surely die; and many lives may, therefore, be saved by a microscopic examination of the blood, which gives the cue for proper and energetic treatment.

Examination of the fresh blood cannot be depended upon by one not skilled in the microscopy of normal and pathologic changes in the red blood-corpuscles; only long practice can give the necessary assurance of judgment. This statement applies with particular force to the serious forms of malaria of the tropical variety, in which the parasites in the peripheral blood are often only tiny specks of protoplasm with little or no pigment. It is, therefore, strongly recommended for the purposes of diagnosis, as an aid to treatment, to place reliance upon one of the staining methods, the best stains for this purpose being one of the modifications of Romanowsky's polychrome methylene-blue, preferably Wright's, Goldhorn's, Giemsa's, or Nocht's.

Practitioners who make a habit of blood examinations in all their fever cases in malarial regions will often be surprised to find a condition totally different from that which the clinical symptoms indicate, and

will obtain much valuable information that will be of the greatest practical aid in treatment.

The limitations of a treatise of this character forbid the consideration of such interesting subjects as the cause of periodicity, the differences in the various malarial parasites, the question of immunity, the finer points in the clinical and microscopic diagnosis, the interesting question of latency, the biology of the parasite, etc. But there is one question which has long been the subject of speculation that we cannot afford to omit, viz., How does the malarial parasite produce the symptoms and the lesions of the disease?

There is little question that the parasite living in the red corpuscles, feeding at the expense of the hemoglobin contained in these bodies, accomplishes the death and destruction of these cells. When we consider the enormous number of red cells commonly infected in any given case, we seem to have one of the principal causes of the anemia which is so frequently a symptom of the disease. This does not account for the periodic paroxysms of chills, fever, and vomiting. It has long been suspected that when the sporulating parasites break, they liberate a toxic substance. A demonstration of this toxin seems to have been made by Rosenau and Francis[1] in their experimental work at Vera Cruz, Mexico, by inoculating healthy individuals with fresh defibrinated and filtered malarial blood.

Treatment

Individual Prophylaxis.—We shall concern ourselves more particularly with the preventive measures useful for individual prophylaxis, rather than with those wide problems of drainage, geographic situation, extermination of the *Anopheles* mosquito and the like which are intended to accomplish the eradication of the disease from a community or region.

In considering malaria we must remember that the same measures which guard the health of the individual residing in an infected region apply with equal force to those having the malarial parasites in their system in order to prevent reinfection. The most important of all the measures of individual prophylaxis is to remain within a well-screened house at night. It must be remembered that the *Anopheles* mosquito, which conveys the malarial infection, is nocturnal in its habits, and that there is little danger of exposing one's self in the bright light during the daytime. By the exercise of this one precaution Drs. Sambon and Lowe[2] lived through the rainy and most malarious season in one of the worst infected portions of the Roman Campagna without suffering any discomfort. They took no quinin and no health precautions beyond the fact that before sundown each day they entered their

[1] Rosenau, Parker, Francis, Beyer, Experimental Studies in Yellow Fever and Malaria, at Vera Cruz, Mexico. Report of working party, No. 2, Yellow Fever Institute, Public Health Marine Hospital Service, May, 1904.

[2] D. C. Rees, A Holiday in a Mosquito-proof House in the Roman Campagna, Jour. Trop. Med., Oct., 1900, p. 62.

house, well screened against mosquitoes, and remained there till daylight the next morning.

It is, therefore, plain that the location of a house in a badly infected region is of secondary importance to thorough protection by screening against mosquitoes. We may, however, aid individual prophylaxis by selecting a house in as high and dry a locality as possible, sleeping in the upper stories, as has often been recommended. We have also found it a distinct advantage in the tropics, as an individual protection against infection, to choose a room facing the trade winds, as mosquitoes cannot fly against the strong winds which prevail in the Antilles and Central America with little cessation throughout the year.

So far as possible the residence should be selected as distant as convenient from the native portion of the city, where the infection is always more concentrated and intense, owing to the fact that almost all of the native population harbor the malarial parasite.

Remembering that the malarial mosquito is paludal, campestral, and sylvan in its habits, breeding by preference in shallow ponds of stagnant water, such a combination of conditions should not be selected for one's activities. Small pools near the house may be drained, or, if that is not possible, treated with petroleum once a week, or, if practicable, stocked with fish.

Where it is impracticable to follow out the above precautions, it is advisable to take 3 to 5 gr. of quinin daily. This amount of quinin seems sufficient to destroy the young and tender forms of the parasites before they have a chance to multiply and cause a malarial outbreak. Recently Koch, in his experiments in Africa, and Grassi, in Italy, have had success in eliminating malaria from a limited infected region by the systemic administration of quinin to all discoverable malarials. Koch recommends 1 gm. every second day; Plehn ½ gr. every fifth day. Good results from the prophylactic use of quinin were obtained on the Panama Canal Zone by the smaller amounts used daily. One objection to the prophylactic use of quinin as pointed out by Stitt and others is that the malarial parasite may become resistent or immune to the effects of quinin. Thus it may be possible to raise a race of plasmodia immune to quinin in the usual amounts, just as Ehrlich has obtained a race of trypanosomes resistent to the effects of atoxyl. It is claimed that those who use quinin as a prophylactic and then stop such use, are apt to have malaria then show unusual resistance to quinin treatment.

Other prophylactic measures should not be neglected, such as attention to the general health, diet, exercise, etc. The resisting powers of the body play an important part in the progress of the disease, such as catching cold, excesses, and any factors depressing the vitality of the system favor the pathogenic action of the parasite. Education is one-half the battle, for a person who thoroughly understands the mosquito theory, and the habits of the *Anopheles* in particular, is well armed to protect himself against its bite.

The outcome of the benign tertian and quartan forms of malarial infection is almost invariably favorable, so far as life is concerned. The

symptoms of these cases often terminate spontaneously, but the natural course of the disease is to relapse and, if untreated, to become chronic, accompanied by severe anemia.

Estivo-autumnal or tropical malaria is a more serious infection and frequently terminates fatally unless actively treated in time. Pernicious symptoms set in sometimes with cruel suddenness and with fatal termination in spite of active treatment. The mortality from this form of the disease in some regions is truly appalling.

The Indications.—The indications for the treatment of malaria are based upon one definite object, viz., the destruction of the parasite in the system. With the disappearance of the parasite the symptoms vanish.

Quinin kills certain forms of the parasites, but has no effect in neutralizing the poison. After destroying the cause of the disease, the next indication in the treatment is to assist nature to restore the great loss of red blood-corpuscles and hemoglobin. This may be aided greatly by iron and arsenic, nourishing diet, and careful attention to personal hygiene. The next important indication is to prevent relapse, so likely to occur. Quinin often fails to kill all the parasites in the system; the few that survive cause a new brood, which increases in sufficient numbers in about seven days to establish a recurrence of all symptoms.

The periodic use of quinin each seven days for several weeks or months is often necessary to eradicate the disease from the system. Finally, the patient must use the prophylactic measures above mentioned to prevent reinfection.

Quinin may be considered a specific remedy for malaria.[1] Still it has distinct limitations. In order to obtain the full benefit of its usefulness it must be given in proper doses at the proper time, and in such a manner that it will be absorbed into the blood.

Quinin is absorbed into the blood rather quickly and most of it is excreted by the kidneys. The hydrochlorate appears in the urine in about ten or fifteen minutes after exhibition by the mouth. The sulphate appears first in the urine forty-five minutes after taking; it is in greatest

[1] "The following is the memorable history of this great discovery, according to Markham (translated by Binz):

"'In 1638 the Countess of Cinchon, the wife of the Viceroy of Peru, lay very ill with tertian fever at Lima, the capital city. The news was carried to Canizares, then Corregidor of Loxa, a town among the Andes in the present Ecuador. Though the natives in Peru were unacquainted with the curative power of the bark, those of the more northern lying countries appreciated its worth, and from them Canizares obtained the secret. He, therefore, sent a parcel of it to the vice-queen. Her physician, de Vega, agreed to its employment, and she recovered in a short time. In 1640 the Countess returned to Spain and carried with her a large quantity of the precious bark, which she distributed about her native place in the vicinity of Madrid. De Vega followed and brought likewise a large amount of the bark to Spain, which he sold at Seville for a hunderd reales a pound. The Countess employed the bark so extensively that for a long time it bore the name 'Countess's powder' (pulvis comitissæ), and Markham asserts that even to-day the fame of her deeds in that region of Spain continues. The Jesuits, who were the missionaries to South America, also did good service in introducing the bark and spreading a knowledge of it,'" Julius Mannaberg, Malarial Diseases. Nothnagel's Encyclo. of Prac. Med., Malaria, Influenza, and Dengue. Philadelphia, W. B. Saunders Co., 1905, p. 452.)

The name "Cinchona" bears testimony to the rôle played by the Countess of Cinchon.

concentration in the blood between three and six hours after exhibition by the mouth. The excretion of the hydrochlorate reaches its acme about the twelfth hour, and after this only traces may be found in the urine up to forty-eight hours. The excretion of the sulphate is completed only after sixty hours.

Quinin is effective against all the various forms of malaria, but not equally so. Small doses given without regard to time or circumstances may effect a cessation of the symptoms of the benign tertian or quartan intermittent fevers, but in severe infections and in the remittent tropical, pernicious, and chronic forms the haphazard usage of quinin may result in actual harm. This harm is manifest either by the poisonous and depressing effects of the drug or the unfortunate result of converting the remittent and intermittent infection into a chronic and irregular disease very difficult to cure.

It is, therefore, very important not only to consider the physiologic action of quinin, but also its relation to the particular parasite which it is desired to destroy in order not to obtain disappointing results. Quinin differs from most other important alkaloids in acting not upon some specialized form of living matter, but on the general nutrition of almost all forms of protoplasm. Its effect upon protoplasm generally consists of transitory augmentation of activity, followed by depression and death. For instance, the central nervous system shows the preliminary stage of stimulation followed by depression. Upon the circulation quinin causes a preliminary contraction of the arterioles and acceleration of the heart, followed by dilatation of the former and slowing and weakening of the latter. It is very important to remember this depressing action of quinin upon the circulation which is often manifested by large doses. Quinin diminishes the number of leukocytes in the blood both in man and in the lower animals. The alkaloid also causes first a slight increase and then a decrease in the nitrogenous material excreted by the kidneys. Quinin, therefore, must not be considered a stimulant in the sense of strychnin or caffein, nor a tonic in the sense of iron and arsenic. Small doses taken before meals improve the appetite similarly to all bitter principles.

The first rational suggestion as to the action of quinin in malaria was brought forward by Binz in 1868, some years before Laveran (1880) discovered the plasmodium. Binz found that very minute quantities sometimes increased the movements of amebæ and infusoria at first; large amounts paralyze them immediately. There is now but little doubt that quinin acts in the same way upon the cause of malaria—viz., by poisoning the parasites. Quinin also possesses definite germicidal powers. In other words, the alkaloid is a poison to almost all unicellular organisms. It is peculiar, however, that certain forms of the malarial parasite obstinately resist the action of quinin and closely allied zoölogic parasites, such as the malarial parasites of cattle, *Pirosoma bigeminum* of Texas fever, are uninfluenced by the drug.

Concerning the action of quinin, there remains some doubt as to whether it acts solely by killing the malarial parasite. Other modes of

action have been suggested, such as preparing the red corpuscles so as to prevent the spores from entering them. Again, it has been suggested that it acts by stimulating the phagocytes, the natural enemies of parasites, by a sort of opsonic power. On the other hand, it has been shown by experiments that quinin paralyzes the leukocytes.

Strange to say, as pointed out by Manson, Steudel, and Küchel, small doses of quinin seem to awaken a latent malaria, just as indiscretions of diet, chilling the body, or other depressing influences. Whether this supposed action of quinin is a coincidence or whether the drug really "stimulates" the plasmodium, so as to produce an outbreak of latent malaria, is undecided.

The Salts and Preparations of Quinin.—Quinin itself is totally insoluble, so that it is necessary to use one of its salts. In this country the sulphate or the bisulphate are commonly used, while in Europe preference is given to the hydrochlorid or bihydrochlorid, also called the hydrochlorate or muriate of quinin. Both from practical and theoretic considerations the muriates of quinin should be given the preference, as these salts contain a larger amount of the alkaloid and are much more soluble than the sulphate.

There are many salts of quinin. The United States Pharmacopœia recognizes the following: Bisulphate, hydrobromid, hydrochlorid, salicylate, and the sulphate.

The following table, modified from Manson, will be found useful:

Solubility and Equivalent Value of Salts of Quinin

Name of salt.	Percentage of the alkaloid in the salt.	Solubility in cold water.	Amount equivalent in value to one of quinin sulphate.
Sulphate	73.5	800 parts.	1.00
Hydrochlorid	81.8	40 "	.9
Bihydrochlodrid [1]	72.0	1 "	1.02
Hydrobromid	76.6	45 "	.96
Bihydrobromid	60.0	7 "	1.23
Bisulphate	59.1	11 "	1.24
Phosphate	76.2	420 "	.96
Valerianate	73.0	110 "	1.01
Lactate [1]	78.2	10 "	.94
Salicylate	70.1	225 "	1.05
Hydrochloro-sulphate [1]	74.3	2 "	.99
Arseniate	69.4	Slightly soluble.	1.06
Euquinin	81.8	" "	.89
Tannate	20.0	" "	3.67
Bichlorid of quinin and urea [1]	59.2	1 part.	1.24

Euquinin or euchinin is almost totally insoluble in water, which accounts for its tastelessness. It is the ethyl carbonized acid of quinin, and consists of a white, crystalline, very voluminous powder. On account of its insolubility it is best administered in capsules or wafers, or it may be given mixed with chocolate, coffee, sugar, milk, etc. On account of its tastelessness it will often be taken by children and fastidi-

[1] These are suitable for hypodermic injections.

ous patients who seriously object to the bitter taste of quinin. Manson, who made a considerable number of trials with this drug, found that it acted promptly on the fever and caused the parasites to disappear from the blood. Good results with euquinin are also reported by A. Plehn and F. Plehn. Gray believes it is even more efficient than quinin. Panegrassi and Conti have had good results in 20 cases in which they observed no bad effects. Mannaberg, who used it in 2 cases of mild malaria with satisfactory results, recommends that, on account of its insolubility, the dose to be administered should be double that of quinin.

The *double hydrochlorate of quinin and urea* is a crystalline substance very soluble in water, which, in addition to its lack of irritating properties, renders it useful for subcutaneous inoculation, especially where a diuretic action is desired.

The *tannate of quinin* is also almost tasteless, because it is exceedingly insoluble. It is used in powders, capsules, or cachets in doses of 15 to 45 gr.

Warburg's Tincture.—Warburg's tincture is a famous combination of many drugs, the principal of which is quinin, and has been extensively used in India and elsewhere in the treatment of malaria. This preparation was originally a proprietary medicine until Warburg voluntarily made its composition known. It originally contained the old *confectio democratis*, a very complex preparation containing thirty aromatic substances, now mostly obsolete; this polypharmaceutical confection is now omitted. Warburg's tincture made in accordance with the National Formulary contains fourteen ingredients, the principal one, of course, being quinin, while some of the other ingredients are entirely superfluous; it also contains aloes, rhubarb, gentian, camphor, and various volatile oils, which have a laxative and diaphoretic action. It is also possible, as Cushny points out, that some of these substances may aid quinin through their effect upon the stomach, for various drugs, such as capsicum and piperin, have long had some reputation as adjuvants to quinin. There is no doubt as to the virtues of Warburg's tincture, especially in the severe remittent and pernicious fevers. Its method of administration is very important to success. After a preliminary clearing of the bowels, ½ ounce of the tincture is given undiluted, all drinks being withheld, and at the end of three hours a second ½ ounce is given in a similar manner. Soon after the second dose a profuse perspiration comes on and the fever is usually broken.

The Amount of Quinin to Give.—The results of experience have taught practitioners in malarious regions to use single large doses rather than small amounts in divided doses. It is now almost the unanimous experience that the maximum effects may be obtained from quinin given in doses of 10 or 15 gr. It is true, as Osler points out, that the benign cases are often checked by 1 or 2 gr. of quinin given night and morning; but these small doses sometimes fail, and to use them in the pernicious or more serious forms of the disease would be unjustified. The heroic amounts sometimes given through mistaken zeal, amounting to 75, 100, and more gr. a day, are entirely unwarranted and likely to cause serious poisoning.

In children under six years the rule of ¾ gr. of quinin daily for each year is generally applicable. Children under one year, therefore, may be given ¾ to 1½ gr.; those from one to four years, 1½ to 6 gr. of quinin a day. In severe infections these doses may, in fact should, be doubled. Children bear subcutaneous injections quite as well as adults (Mannaberg).

Time of Administration.—The result of long experience, supported now by theoretic considerations, teaches that the best time to give quinin is several hours (three to six) before the expected attack, so that it will be in the blood in maximum concentration at the time of the paroxysm when the spores are liberated. It is believed, as first pointed out by Golgi, that the spores are the most susceptible form of the parasite to quinin. When given subcutaneously or into a muscle or vein, the best time in intermittent fever is one hour before the paroxysm.

The drug is often administered with good effect immediately after the subsidence of the fever in order to kill the young ameboid forms of the parasite before they have a chance to segment. Quinin should not be given during the paroxysm of an intermittent fever unless pernicious symptoms threaten. The usual rule in intermittent cases is to give it during apyrexia.

In the remittent and continued fevers, especially of estivo-autumnal character, no time should be lost in giving the drug.

Methods of Administration.—Quinin is usually given by the mouth. If the bitter taste is not objected to, it is best administered in solution. If given in pills, care must be taken that they are soft and freshly prepared, as when kept for any length of time they become hard and insoluble, and in this condition frequently pass through the bowel unabsorbed. If given in pills, capsules, or cachets, it is advisable to follow the administration with a draught of hydrochloric acid lemonade, which favors solution and absorption.

In very young children who cannot swallow pills and who refuse to take the bitter solution, euquinin may be tried with a little sugar or chocolate. In the case of young children or in the case of contra-indications to the use of quinin by the mouth, such as gastric irritation or vomiting, resort may be had to rectal injections; about twice the amount should be given by rectum on account of the difficulty of absorption from the lower bowel. The retention of the enema may be favored by using it warm, by keeping the patient quiet in bed, holding the buttocks closed, and by guarding the solution by a few drops of tincture of opium. A cleansing injection must be given previously. The following may be used in one clyster:

℞. Quininæ hydrochloridi.....0.5 to 1.0 gm.
Aquæ.....200 cc.
Tincturæ opii.....10 gtt.—M.

or, for suppositories,

℞. Quininæ hydrochloridi.....1.5 gm.
Olei theobromatis.....q.s.—M.
Sig.—Suppositoriæ No. v.

In malarious regions practitioners have learned from experience that the effect of quinin is often greatly enhanced by preceding it with a brisk cathartic, preference being given to calomel or the compound cathartic pills (United States Pharmacopœia). We have found the good effects of cathartics to be especially evident in the remittent, bilious, and chronic types of the disease.

In chronic cases, especially in habituées to alcohol, the absorption of quinin may be greatly favored by combining it with a little capsicum, using about 1 gr. to the dose.

Quinin may also be given by inoculation into the subcutaneous tissues, into the muscles, or directly into a vein.

The subcutaneous inoculations of quinin are not to be recommended, for the method is painful and absorption comparatively slow. Deep injections into the muscles are less painful, produce quicker results, and are less likely to produce local inflammations. The gluteal muscles are the muscles of election. Ashley-Emile[1] recently reports the treatment of 50 cases with sixty-seven intramuscular injections of quinin with no bad results. He uses quinin hydrochlorid dissolved in water and boiled, then adds a drop or two of hydrochloric acid to dispel turbidity. Ashley-Emile claims that quinin given by this method often succeeds when large doses by the mouth fail. He advocates it on account of its economy, certainty and rapidity of action, especially when administration by the mouth is not feasible, and lastly, when intolerance is established by excessive doses of quinin taken as a prophylactic. The subcutaneous or intramuscular injections are contra-indicated in cases suffering from ulceration or septic diseases and in very young children.

The intravenous injection of quinin is the most direct route, and in our opinion has many advantages. There is practically no danger of abscess, slough, or inflammatory reaction. All the quinin enters the blood-stream and produces its maximum effects at once. The method is easy and comparatively painless. One of the superficial veins at the bend of the elbow is selected. A rubber band or fillet compresses the veins above; the skin is cleansed with the same care used in a surgical operation; the needle is introduced directly into the vein below upward without first cutting the skin. Before injecting the solution it is well to first withdraw the piston slightly, to be sure that the needle is in the vein, and then the contents of the syringe slowly injected, care being taken to avoid the injection of air. In this way 1 gm. of the muriate of quinin may be introduced directly into the blood and repeated in six, eight, or twelve hours, as the symptoms of the case may require. In one of our cases at Vera Cruz we used as much as 120 gr. within forty-eight hours in a severe case of pernicious fever, with the happiest results.

While the injection of quinin directly into the blood or tissues is the quickest, surest, and most economic method of administering the remedy, it requires the strictest attention to asepsis to prevent serious complica-

[1] Ashley-Emile, Treatment of Malarial Fever by Intramuscular Injections of Quinin, Jour. Trop. Med., April 15, 1905, p. 117.

tions. Abscess, sloughing, sepsis, and tetanus have been caused by lack of attention to these matters. The syringe and needle must be carefully sterilized, preferably by boiling; the solution should be made with pure water boiled a sufficient length of time to insure the destruction of tetanus spores; and after the quinin is added, the solution should again be boiled and injected while lukewarm. The muriate of quinin is found on the market in sterile solution in hermetically sealed glass tubes, which are very convenient in tropical climates where facilities for carrying out aseptic and antiseptic precautions are often lacking.

Baccelli was the first to suggest the intravenous injection of quinin when prompt and energetic treatment is necessary. His formula is:

℞. Quininæ hydrochloridi ..... 1.00 gm.
Sodii chloridi ..... 0.075 gm.
Aquæ destillatæ ..... q. s. ad. 10.00 cc.—M.

Another solution which has been recommended and which may be kept on hand for emergency in malarious regions is as follows:

℞. Quininæ hydrochloridi ..... 5.0 gm.
Aquæ destillatæ ..... 10.0 cc.—M.

Each cubic centimeter, therefore, contains 0.05 gm. (about 1 gr.) of the salt.

Kobner recommends:

℞. Quinine hydrochlorate ..... 0.5 to 1.0 gm.
Glycerine,
Distilled water ..... āā 2 gm.—M.

Triulzi adds antipyrin to promote solution and diminish pain. Vincent and Burot add analgesin, and Gaglio uses urethane.

It is interesting to note that the injection of 1 gm. of quinin directly into the vein makes a solution with the whole blood in about the proportion of 1 to 5000.

Contra-indications.—In general, it may be stated that quinin is often credited with many disadvantages that it does not possess, and that in case of malaria, in which it is without a rival or substitute, only the most pronounced idiosyncrasy can justify withholding it. The contra-indications to the use of quinin may be summed up as (1) idiosyncrasy, (2) inflammatory condition of the internal auditory apparatus, and (3) marked disturbance of digestion.

Some persons show an intolerance to quinin which cannot be disregarded. This idiosyncrasy does not refer to the ringing in the ears, temporary deafness, headache, etc., complained of by most persons taking full therapeutic doses, but to certain serious symptoms of depression, labored breathing, weakening, and even collapse, that sometimes result from ordinary doses.

There is every reason to believe that quinin affects the sense of hearing by causing a congestion of the auditory canal and its membranes; that it is attributed to a circulatory disturbance and not to central brain effects. This congestion, therefore, may readily set up an inflammation

which may become chronic and permanently impair the hearing. Quinin possesses some irritant action which betrays itself in disturbance of the stomach, eructations, and sometimes vomiting. Its local irritating action is also evidenced by the pain and tenderness caused by subcutaneous injections. Marked disturbances of digestion are only contra-indications to the administration of quinin by the mouth. In such cases resort should always be had to the rectal, intramuscular, or intravenous administration of the drug.

In small doses quinin seems to be a slight, temporary stimulant to the muscles, but this is soon replaced by depression. This action upon the muscular tissues is sometimes especially evident on the uterus. Abortion certainly occasionally occurs after its use, but whether due to the malarial infection or to the quinin is a question. Labor-pains sometimes seem to be strengthened by the use of quinin, but it is very doubtful whether they can be initiated. While pregnancy is not a contra-indication to the use of the drug in the case of malaria, it should be used guardedly in this condition.

The relations of quinin to hemoglobinuria and to albuminuria will be discussed under Blackwater Fever.

Other Drugs in Malaria.—No other remedy can take the place of quinin in malaria. Nevertheless, from time to time certain substances obtain a certain vogue, especially in the benign types of the disease. The more important of these substances follow:

The *other alkaloids found in cinchona bark*—viz., cinchonidin, cinchonin, chinidin, and chinoidin—have been tried more or less extensively, but have failed, and their use in malaria is now practically abandoned. Laveran states that sulphate of cinchonidin, much used by the French physician in the colonies, although useful in light infections, has been recognized as non-efficacious in grave infections. Other writers, as De Brun and Spitzner, have reported satisfactory results with salts of cinchonidin. Marty, on the other hand, condemns it as being much less efficient than quinin and much more toxic.

Arsenic.—Next to quinin, arsenic is perhaps the most valuable remedy in the treatment of malaria, but it must be remembered that arsenic cannot take the place of quinin. It has no apparent action during the febrile stage, nor does it exert a poisonous effect upon the parasites in the blood. Its use is as an alterative. It is indicated in the old, chronic, anemic, and convalescent cases. It is also useful for treatment of malarial neuralgia. Fowler's solution is the favorite method of administering arsenic, beginning with 2 to 10 drops in water and increasing the dose by one drop daily in the usual way.

Methylene-blue (medicinal) was first recommended by Ehrlich and Guttmann,[1] who were led to its use on account of the special affinity this anilin dye has for the living malarial parasite, noted by Celli and Guarmieri. It is given in doses of from 2 to 3 gr. every (?) hours and continued until the urine becomes deeply tinged or signs of kidney irritation appear. Methylene-blue is supposed to attack especially the

[1] Ehrlich and Guttmann, Berlin. Klin. Jahrb., 1891.

parasites of irregular fevers and the crescent bodies upon which quinin seems inert. F. Plehn found it very uncertain in its action, which corresponds to the testimony of others who have given it a trial. Patients should be warned that the urine becomes greenish or blue after taking this analin dye, which disappears upon the addition of an alkali. This phenomenon persists from two to eight days after the discontinuance of the remedy.[1] The freshly evacuated stools appear of usual color, but after a few moments in contact with the oxygen of the air the surface becomes bluish green.

Marchiafava and Bignami do not encourage the use of the drug on account of the strangury, diuresis, and temporary albuminuria which it may produce.

Craig has seen good effects from the use of the drug, but finds it very much less valuable than quinin.

The remaining drugs used in malaria may be discarded with brief mention.

Anarcotin was at one time, according to Manson, extensively and successfully used in India during a quinin famine. The dose is from 1 to 3 gr.

Creosote has been recommended by Fitzgerald[2] for children. He used it in the form of inunctions, rubbing in 15 to 20 drops, mixed with equal proportions of olive oil, daily.

Phenocoll.—The hydrochlorate of phenol, a derivative of phenacetin, in doses of 1 to 1.5 gm., was at one time extensively used in Italy. The best observers, however, found that while it is sometimes effective in the mild tertian and quartan fevers, it is ineffective in the estivo-autumnal infections; not only was the drug found ineffective, but sometimes it produced serious poisonous symptoms, even collapse. This drug has been investigated by Albertini, Pucci, Noir, Anconi, and F. Plehn.

Treatment of Intermittent Fevers.—It is not advisable to administer quinin during the paroxysms of the benign tertian and quartan fevers. To give it then increases the headache, does not modify the chill, fever, or sweat, and is very apt to increase or bring on the nausea and vomiting.

As soon as the paroxysm is over, 10 gr. may be given by the mouth and repeated every six or eight hours for three or four days. This method of using quinin will not always prevent the next attack, but will, in the great majority of cases, check the further development of symptoms. Every seventh day 10 or 15 gr. of quinin should be taken to prevent a relapse, and this weekly administration of the alkaloid should be continued for a month or two. In the meantime, tonics, such as iron and arsenic, may be given to aid in the reconstruction of the blood.

The method of giving quinin for these benign intermittent fevers, recommended by Marchiafava and Bignami,[3] is to give one large single

[1] B. Scheube, The Diseases of Warm Countries, London, 1903.

[2] A. O. Fitzgerald, The Treatment of the Malarial Fevers by the Inunction of the Creosote, Brit. Med. Jour., July 15, 1899, p. 140.

[3] Ettore Marchiafava and Amico Bignami, Malaria, Twentieth Cent. Prac. Med., vol. 19, p. 1522.

dose of about 15 gr. at the end of the attack and to repeat this dose six or four hours previous to the time at which the attack usually begins.

The object is to give the quinin during the period of apyrexia in such a manner that the largest dose shall be given a few (about four) hours before the attack in order that the maximum amount of quinin may be in the blood to meet the spores and the young tender forms of the parasite. The same dose is repeated for two or three days following, and in order to avoid relapses Marchiafava and Bignami recommend that it be repeated every sixth day for a month or more.

The paroxysm itself of the benign forms of malarial fever rarely needs special treatment. If the chill is prolonged and severe, hot drinks may be taken; during the febrile stage, cold acidulated drinks are grateful. The perspiration should not be checked. For the headache, which is often the most distressing feature of the paroxysm, cold applications to the head give relief; for the vomiting, cracked ice. If the chill, headache, or vomiting are very distressing, a hypodermic of sulphate of morphin may be called for.

It is unusual to see the intermittent quotidian and tertian paroxysms due to the estivo-autumnal parasite in civilized communities. Such cases are met with mainly in the natives in regions where the disease is uninfluenced by quinin and where the patient has a primary and uncomplicated infection. These cases should be treated in the same manner as above indicated for the benign intermittent fevers, except that in view of the virulence of this species of the malarial parasite maximum doses of quinin will be called for.

If pernicious symptoms make their appearance during a paroxysm, no time must be lost in giving the quinin, which is then best administered directly into a vein.

Quinin is a specific in the truest sense of the term in uncomplicated cases of intermittent malarial fever, as there is scarcely such a case on record in which quinin has failed to check the disease.

Treatment of Remittent, Continued, and Irregular Malarial Fevers.—The treatment of these forms of malarial fever is not always so satisfactory as the typic intermittent forms of the disease. The response to quinin is not always so prompt. Convalescence is often tardy and relapses are frequently met with. There are several reasons for this. One of the chief reasons is that these fevers are usually caused by the estivo-autumnal form of the parasite, which is more virulent and is often present in the blood in much greater numbers than the benign parasites. The paroxysms caused by the estivo-autumnal parasite are of much longer duration and are, therefore, more apt to run into each other, giving rise to the remittent fever. Further, irregular sporulation is more common in this infection than in the benign species, giving rise to the continued and irregular fevers. Mixed infections, chronic malaria, and a weakened constitution which allows feeble response are also factors which determine these variations from the typic periodicity.

In the treatment of these cases it is always advisable to insist upon the patient staying in bed as long as the temperature is above the nor-

mal. A soft, nourishing diet of milk, eggs, soups, etc., should be given and the case treated generally upon the usual practice in typhoid fever.

In the remittent fevers caused by the benign tertian or quartan parasites, especially when quinin has already been given in insufficient doses and in an irregular manner, it will be well to suspend the alkaloid for a few days, using calomel in laxative doses and allowing the diet and rest to restore the tone of the patient. Mannaberg questions whether calomel is justified under all circumstances in bilious remittent fever. He considers that intestinal activity should be regulated in the same way in malaria as in any other infectious disease, and that irrigations and saline purgatives in suitable cases meet these indications fully. Then quinin may be given in 10- to 15-gr. doses every six or eight hours for two or three days, care being taken that it is administered in a proper form to insure absorption. It is in these cases that Warburg's tincture (*q. v.*) is especially useful. Rest in bed seems to favor the action of the quinin.

In the remittent and continued forms of tropical malaria due to the estivo-autumnal parasite no time should be lost in the administration of the drug for fear of pernicious symptoms. In the tropical variety of malarial fever if a satisfactory response to quinin is not obtained from 15- to 20-gr. doses by the mouth, the drug may be given into a muscle or directly into a vein, using 1 gm. of the muriate.

It must be remembered that in these fevers a blood examination is the only basis for the proper time to administer quinin. If crescents alone are seen on microscopic examination, quinin is useless. As long as ameboid parasites are present in the blood the quinin should be pushed until they disappear. In these cases, as pointed out by Mannaberg, we have to do with a fractional sterilization of the blood.

The destruction of the red blood-corpuscles and the hemoglobin is often very severe in these cases, due doubtless to the great numbers of infected corpuscles. Convalescence is, therefore, sometimes slower than in the benign types of the disease. Iron and arsenic are, therefore, particularly indicated in such cases, in addition to nourishing diet and attention to personal hygiene. The same precautions must be taken to prevent relapses as in the intermittent fevers—viz., by the periodic administration every seventh day of 10 or 15 gr. of quinin.

Pernicious Attacks.—Grave symptoms occurring during the course of intermittent or remittent fevers constitute the terrible pernicious malaria. In Italy these cases occur mostly in the summer and autumn, hence the name *estivo-autumnal* fever. In our own tropical regions they usually make their appearance with the rainy season, which corresponds to our late fall or early winter months.

Pernicious symptoms may begin treacherously or come on with brutal abruptness, occasionally after premonitory signs, such as stupor, delirium, or other mental symptoms, indicating a concentration of the poison in the vital organs.

It is now generally conceded that the cause of pernicious symptoms is (1) the virulence of the estivo-autumnal parasite and (2) their abun-

dance. It is well to remember that the sporulating forms which liberate the toxin may be present in great numbers in the capillaries of the brain and other internal organs, while comparatively few of them are found in the peripheral blood as it is examined by the usual microscopic technic. This form of malaria must always, therefore, be treated energetically and without delay on account of the dangers involved.

The pernicious fevers take their name from the predominating symptom, as comatose, delirious, tetanic, hemiplegic, choleraic, algid, dysenteric, hemorrhagic, etc. The treatment must be prompt and energetic in order to save the life of the patient. The whole object is to get the quinin into the blood, and that is best done by intravenous inoculation of from 1 to 2 gm. of the muriate of quinin, repeating similar doses in six to twelve hours until an impress is made upon the symptoms.

In pernicious attacks symptomatic treatment will help the specific remedy. For the delirium and agitation, morphin is useful; for the prolonged high temperature, baths; for cardiac weakness, caffein, camphorated oils, strychnin, etc. In the algid forms, stimulation, friction, wrapping in warm flannels, hot drinks, etc., are called for. In choleraic and dysenteric forms, opium is often necessary for the pain and to check the discharges until the specific remedy takes effect. For the grave anemia which sometimes occurs in pernicious attacks hypodermoclysis is indicated.

Certain of these symptoms, owing to their frequency and gravity, are dealt with somewhat in more detail.

Hyperpyrexia is an exceedingly dangerous symptom and must be promptly met to prevent a fatal termination. Manson lays down a good rule—to give a cold bath when the temperature reaches 106° F. In addition to the iced bath, rectal injections of cold water, ice-bags to the head, and the usual means employed to lower dangerously high temperature must be resorted to.

The *algid* form of pernicious attacks calls for the opposite form of treatment to hyperpyrexia. The indications are now for external warmth, such as warm bottles or warming bags, hot baths to which a little mustard may be added, also frictions and stimulants. In this condition alcohol in the form of rum, brandy, or champagne may be used; this is almost the only condition in malaria in which alcohol is advisable.

Coma.—The bowels and bladder should be evacuated. Counter-irritation may be practised. In robust individuals leeches may be applied to the mastoid processes. Venesection is not advisable.

Malarial Cachexia and Anemia.—The successful treatment of this chronic form of malaria will depend largely upon careful instruction on the part of the physician and intelligent coöperation on the part of the patient.

If possible, a change of climate is an important aid in treatment. A cold, dry, sunny climate or a sea voyage may be selected. Sudden changes must be avoided, especially in the winter time. It is well known that persons leaving malarious regions of Cuba or Central America, feeling perhaps in good health at the time, suffer with severe malarial

attacks upon reaching resorts in the Alleghenies, the Jersey coast, or the more northerly places to which they often resort for health. It has been our experience that following the Spanish-American War many cases of malaria developed on the troop ships leaving Cuba when the cold winds of Hatteras were reached.

Manson points out the fact that many fatalities occur yearly in cachectics from West Africa during the voyage to Europe. These patients should exercise great caution not to expose themselves to the fresh sea breezes on such voyages.

If a change of climate becomes necessary during the winter, it is advisable, if possible, to travel northward by easy stages. It is also recommended that if quinin is being taken when the patient leaves the malarious region, it should be continued during the voyage and for some months following, as a prophylactic.

All authorities agree that for the reduction of enlarged spleen and liver, which is always found in chronic malaria, the use of laxative mineral waters is beneficial: in Italy, Montecatini or Chianciano; in Germany, Carlsbad and Kissengen; in France, Vichy. In cases of severe anemia the waters containing iron and arsenic are to be preferred, as Franzenbad, St. Moritz, Elster, Schwalbach, Levico, Roncegno, La Bourboule, etc. Citrate of magnesia, Seidlitz powders, and Epsom or Rochelle salts in proper doses make good substitutes for the natural mineral waters. Iron and arsenic are especially indicated in these conditions for the anemia. There are many elegant pharmaceutic preparations containing these drugs sometimes combined with strychnin or quinin. The elixir of quinin, iron, and strychnin phosphate of the United States Pharmacopœia is a splendid restorative in such cases. The iron may be given in Blaud's pills or one of the organic salts now so popular. As an antimalarial and excellent tonic in chronic malarial infections and cachexia, Baccelli recommends the following mixture:

℞. Quininæ sulphatis.....3 (gr. xiv)
Ferri et potassii tartratis.....7 (gr. cv)
Liquoris potassii arsenitis.....gtt. xxiv
Aquæ destillatæ.....300 (x).—M.

As a rule, quinin itself has little influence in the chronic, cachectic, and anemic cases, but may be used before meals as a stomachic bitter tonic to improve the appetite. This use of the drug also aids in preventing relapses of the febrile attacks which are so apt to occur in this class of cases.

Critzmann[1] recommends bone-marrow and spleen in cachexia. In four cases with splenic tumor, edema, etc., he claims to have had good results which were manifest in two to four weeks. He gave at every meal the following mixture in an unmasked condition:

℞. Beef spleen.....50 gm.
Bone-marrow.....10 "
Yolk of one egg.

[1] Critzmann, Sur un mode de traitement de l'impaludisme, Bull. de l'Inst. de Med., 1895, 34, p. 724.

Chronic malaria is caused by the continuance of the infection of the organism for months or years with occasional clinical exacerbations. In no other infection is the anemia more profound than in some of these cases. The number of red blood-cells is often rapidly lowered to less than 1,000,000 per cubic millimeter and the hemoglobin is diminished in proportion. The severe degree of anemia is often evident not alone by the pallor and blanching of the mucous membranes, but by the watery condition of the blood, which is discernible to the naked eye. This condition of the blood is sometimes so extreme that it is difficult to obtain a drop from the capillary circulation of the finger-tip or lobe of the ear sufficiently large to make a satisfactory microscopic examination.

It is very important not to confound this condition with the severe anemia produced by hookworm disease. Many of these cases are confused, with the result that treatment is misdirected. It is also important to carefully differentiate chronic malaria from kala-azar or dumdum fever, the prominent symptoms of which are enlarged spleen and anemia.

It is unfortunate that many cases of chronic malaria are in poor, ill-nourished persons who are required to work beyond their strength. Such individuals, unable to change their residence or conditions of life, are constantly subject to reinfection, which makes treatment very difficult. Their treatment becomes more a sociologic than a medical question.

The general symptomatic treatment in malarial cachexia is of the greatest importance as an adjunct to success. The remedial treatment is secondary to the dietetic and hygienic measures. The patient should have a nourishing but simple diet, plenty of rest, well-regulated exercise in the open air and sunshine. It is important to avoid excesses of all kinds, and especially to prevent chilling the body while perspiring and other depressing influences.

The **latent** and **masked forms** of malarial fever deserve attention. We may find these conditions to be much more frequent than is usually suspected. Craig[1] thinks them so common that "if the truth could be known it would be so astounding as to be almost unbelievable." He draws a distinction between the latent and the masked forms:

Latent malarial fever being that condition in which the parasites can be demonstrated in the blood and no clinical symptoms of any disease are present.

Masked malarial fever being that form in which the parasites are present in the blood, but the symptoms present are those of another disease or are atypic.

Cases of masked and latent malaria are most commonly found in this country outside of the malarial regions in returning soldiers and travelers from the tropics, particularly the Philippines, the Antilles, Panama, and Central American places. These cases often have no febrile attacks. In fact, the temperature may be subnormal. Often nervous symptoms, such as headache, vertigo, neuralgia, diarrhea, or dysentery

[1] Charles F. Craig, The Estivo-autumnal (Remittent) Malarial Fevers, New York, Wm. Wood & Co., 1901, p. 220.

may be present. The treatment of these conditions will succeed or fail depending upon the accuracy of the diagnosis, which can only be established by a microscopic examination of the blood. The depressed vitality of these persons seems to render them more subject to other diseases, especially typhoid fever and pneumonia.

Relapses.—The treatment of malarial fever is incomplete without guarding against its tendency to relapse. All these infections—quartan, tertian, and tropical—are prone to relapse after the cessation of symptoms spontaneously or as a result of quinin. Relapses are especially prone to occur on the seventh and fourteenth days, but they may be delayed for months and years.

The return of the fever is favored by any depressing conditions, such as chilling the body, abrupt traveling from warm to cold climates, dietary troubles, overwork and malnutrition, mental suffering, or intercurrent diseases. The parasites persist in the system for a very long time, resuming their activities when the defense upon which organisms depend is weakened.

The treatment of malaria, therefore, does not stop with the cessation of the acute paroxysm, but consists in the judicious use of tonics combined with dietetic and hygienic regimen in addition to the periodic use of quinin. Two methods of administering quinin are used to prevent relapses. One is to give large doses every fifth, sixth, or seventh day, and the other is the use of smaller doses daily for a long time. The first method appears to be the best, and a good rule is to instruct the patients to take 10 or 15 gr. of quinin every Sunday, as suggested by Manson. The use of smaller doses of quinin (3 to 5 gr. a day) is recommended more as a prophylactic.

HEMOGLOBINURIC FEVER

Hemoglobinuric fever is a condition found almost exclusively in regions severely infected with the tropical (estivo-autumnal) form of malaria. It is characterized by fever, the passage of reddish-black urine, and by jaundice. The condition had, until recently, been regarded generally as a pernicious form of malarial fever. The relation to malaria has been questioned, especially by R. Koch,[1] who observed a number of these cases in Africa, and who is inclined to regard hemoglobinuria as nothing more or less than quinin-poisoning.[2]

Hemoglobinuric fever is also known as bilious or icterohemoglobinuric fever, malarial hemoglobinuria, and schwarzwasserfieber (blackwater fever); also, sometimes erroneously called "hematuric" fever.

The geographic distribution is a fairly large one and coincides strictly with the tropical regions where malarial disease is most intense.

Its principal distribution is along the flat coasts of tropical Africa,

[1] Robert Koch, Reise-bericht über. . . . tropische Malaria, Schwarzwasserfieber. . . . Berlin, Julius Springer, 1898, pp. 118–124.

[2] Tomaselli, in 1874, was the first to point out the relation between quinin and hemoglobinuria.

where it was first described by French naval surgeons about 1820.[1] It also occurs in Madagascar, Mauritius, Asia Minor, Siam, and Cochin China; in India it has but recently been observed in the few notoriously malarial centers of Assam, Upper Burmah, and also Terai, at the foot of the Himalayas.

In the Western Hemisphere hemoglobinuric fever is met with in the southern part of the United States and in the West Indian Islands, Central America, Venezuela, Guiana, and a few districts of Brazil. It is rare in Europe; it has been observed in a few river valleys of Spain, but in Italy it was not noted by the classical writer Torti, who had a large clinical experience. It has, however, recently been observed on the Roman Campagna, also in Sicily, Sardinia, and in Greece.

According to Mannaberg[2] different races show a varying predisposition to hemoglobinuric fever. Europeans suffer most frequently; negroes are seldom attacked. In some places Chinese suffer severely. The disease also affects Malays, Tonquinese (La Ray), and Indians (Rothshub) in Nicaragua. Both sexes are alike susceptible. Children are not immune to it. Some persons show an evident individual predisposition to the disease. It has been often observed that blackwater fever occurs after departure from the malarial region, especially on shipboard. Thus, cases have been seen in cities far removed from malarial regions.

One attack renders a person more liable to subsequent attacks. There are records of patients having had as many as twelve hemoglobinuric attacks. F. Plehn himself has had five.

As the treatment of this disease varies radically according to the conception of its nature, it will be necessary to consider briefly the divergent views which have been brought forward to account for the morbid process.

The pathogenesis of blackwater fever is not only obscure, but is also probably complex. The prominent feature of the disease which gives rise to the highly colored urine is undoubtedly due to a hemolytic agent in the blood. Ordinarily in malaria the parasite and its toxins do not cause a solution of the hemoglobin. The likelihood, therefore, of hemoglobinuria being dependent directly upon the malarial parasite or its poisonous products has been very much questioned. During attacks of hemoglobinuria the malarial parasites may be absent from the blood or be present in very few numbers, which gives a certain plausibility to the views held by those who see no causal relation between the plasmodium and this blackwater fever.

[1] "The first reports of this peculiar and, in many ways, interesting affection, the genesis of which is not yet fully understood, came from French naval physicians, who observed it at Mayotte and Nossi Bé (Lebeau Daullé Le Roi de Méricourt). It was likewise physicians of the French marine who showed its occurrence on the west coast of Africa and in America (French Guiana, the Antilles), and gave a complete description of the clinical picture (Dutrouleau, l'Herminier, Barthélemy-Benôit, Bérenger-Féraud, Pellarin, Corre, O'Neill, and others)." Mannaberg, Malarial Diseases, Nothnagel's Encycl. of Prac. Med., Am. ed., p. 307.

[2] Julius Mannaberg, Malarial Diseases, Nothnagel's Encycl. of Prac. Med., Am. ed., Philadelphia, 1905.

Quinin alone apparently possesses no hemolytic power, and in many malarious countries where it is extensively used in large doses hemoglobinuria does not occur. Nevertheless, quinin by many writers is considered as the chief agent in the pathogenesis of the condition. As some of these cases have been observed to occur during the course of a malarial attack in patients who have not taken quinin recently, there can be no doubt that quinin is not responsible for all the cases. Observations, on the other hand, have demonstrated that in certain malarial subjects the exhibition of quinin brings on an attack of hemoglobinuria with such constancy that there can scarcely remain any doubt as to its causal relation.

F. Plehn[1] observed 43 cases of blackwater fever which came under his observation in Cameroon, 24 of which positively broke out a few hours after the administration of quinin.

A. Plehn[2] treated 55 cases of blackwater fever in Cameroon, 48 cases of which directly followed the use of quinin. Most attacks set in from two to four hours after the administration of quinin. In rarer cases, probably in consequence of delayed absorption, the attacks commenced later, even as much as ten hours after.

All authorities admit a certain relation between hemoglobinuria and malaria, even though they do not consider the malarial parasite to be the cause of the syndrome, and although there is a great diversity of opinion expressed by the different writers upon hemoglobinuric fever, all are unanimous in associating it with one particular species of the malarial parasite, viz., the tropical or estivo-autumnal (*Plasmodium falsiparum*).

Hemoglobinuria, as is well known, may occur in the course of various infectious diseases, such, for example, as scarlet fever, acute articular rheumatism, pneumonia, chronic suppurative conditions, etc.; but it is in the hot malarial regions where the condition is common. The condition may appear during the course of an active infection, as well as during one that has spent its force. That is, we may find either (1) ameboid or signet-ring forms of the tropical parasite, (2) only crescents or pigmented leukocytes, or (3) no parasites at all.

That the malarial parasite may be entirely absent from the peripheral blood of hemoglobinuric fever patients is now well known. Koch saw 41 cases, in but 18 of which were malarial parasites found in the circulating blood.

Hemoglobinuria almost always occurs in persons who have lived in malarious regions a very long time and in persons whose systems have been more or less saturated with the infection. In such cases of chronic malaria it is well known that the sporulating parasites and the pigment, etc., accumulates in great quantities in the enlarged spleen, the bone-marrow, and other internal organs, while at the same time they may

[1] F. Plehn, Ueber die praktisch verwertbaren Erfolge der bisherigen ätiologischen malariaforschung, Arch. f. Schiffs-u. Tropen-hyg., i, 1897, No. 6, 384.

[2] A. Plehn, Die Ergebnisse einer Umfrage über das Schwarzwasserfieber, Arch. f. Schiffs-u. Tropen-hyg., iii, 1899, No. 4, 230–244.

be few or wanting in the peripheral circulation. The influence of such a chronic condition upon the hematopoietic organs cannot be neglected and may account for the origin of the hemolytic agent.[1]

Other causes have been ascribed to hemoglobinuric fever. Pellarin[2] and others located the site of the disease not in the blood, but in the kidneys, as they regarded renal hemorrhage (apoplexie rènale) as the source of hemoglobinuria. Yersin believes that hemoglobinuria is an associated phenomena or complication of malaria due to a small bacillus which he found in the urine of two patients. These observations, however, lack confirmation, for Berthier, on the other hand, failed to find micro-organisms in the urine which was obtained with strict bacteriologic precautions.

Sambon[3] brings forward a very ingenious suggestion that in his opinion blackwater fever is a specific disease similar to Texas fever of cattle caused by the *Pirosoma bigeminum*, in which affection hemoglobinuria is a prominent symptom.

F. Plehn and others also speculate upon the possibility of hemoglobinuric fever in man being caused by a distinct species of the malarial parasite.

The outcome of the disease, even in grave cases, is often favorable. Spontaneous recovery is not uncommon and may even take place after prolonged and grave attacks. The mortality rate, according to different writers, varies within rather wide limits—from 9 to 10 up to 70 per cent. F. Plehn considers 10 to 12 per cent. the average.

The intensity of the jaundice is an index to the gravity of the attack. Hemoglobinuric fever varies greatly in duration and in gravity, and the condition is very apt to recur after the cessation of all symptoms. All authors agree that in prognosis we must take into consideration especially the condition of the renal functions, the heart, and the nervous symptoms.

Treatment.—There are few conditions in tropical pathology which the physician has to face that will require greater skill on his part than the treatment of a case of hemoglobinuric fever. The life or death of the patient may depend upon his insight into the pathology of the syndrome, a correct understanding of the physiologic action of quinin, and finally, a familiarity with the use of the microscope.

There is no specific remedial therapy for hemoglobinuric fever. The poison must gradually be eliminated from the body through the natural channels, especially the kidneys and skin. Therefore, the importance of plenty of fluids and the encouragement of sweating, and, on the other hand, the prevention of those influences which are well known to check the excretion of urine and perspiration. The hemoglobinuric paroxysm often subsides spontaneously; hence, energetic treatment may cause harm.

[1] L. Vincenzi, Sull' intoccicazione da chinana nei malarica, Ann. Ital. di Clin. Med., xxxvi, 1897.

[2] Pellarin, Des fievres bilieuse des parp chaudes, Paris, 1876.

[3] L. Westenra Sambon, Blackwater Fever, Brit. Med. Jour., 1898, Sept. 24, p. 860. The Etiology and Treatment of Blackwater Fever, Jour. Trop. Med., 1899, pp. 243, 262, 295.

There are two chief methods in vogue for the use of quinin as a prevention of hemoglobinuric fever: Plehn's method, ½ gr. every fifth evening, and Koch's, 15 gr. on two successive days.

According to the 1903 statistics of Cameroon there were among those who used quinin regularly 12 cases of black-water fever, of which 8 employed the Plehn method, 3 first Plehn's, then Koch's, and only 1 Koch's method regularly. Of 35 cases among irregular users 17 employed the ½ gm. method, and only 3 the 15 gr. method. From these figures it is evident that Koch's method is preferable, even when not systematically employed.[1]

All the measures recommended for prophylaxis against malaria apply with equal force to hemoglobinuric fever. In addition, patients who are threatened with hemoglobinuria or who have had this disease before, on the slightest indication of fever should go to bed at once, keep their skin warm and scrupulously protected from draughts, also drink plenty of warm fluids. If the ameboid parasites are present in the blood, moderate doses of quinin may be given with great caution, carefully watching the urine. At the same time a laxative dose of calomel will be beneficial. Those who have suffered from hemoglobinuria must at all times avoid, above everything, getting wet or chilled, overfatigued, and all other causes of physiologic depression. Sitting down to cool off in clothes wet with perspiration is most dangerous (Manson).[2]

Hemoglobinuric attacks not uncommonly occur in persons who change climate too suddenly from a hot to a cold region. F. Plehn had one of his attacks in Berlin.[3]

From what has been said regarding pathogenesis of hemoglobinuric fever it is evident that, so far as treatment is concerned, we are really dealing with two distinct affections: The one a malarial hemoglobinuria, the other a quinin hemoglobinuria; the first being due more directly to the influence of the malarial infection, the second being due indirectly to the poisonous effects of quinin in malarial patients. It is plain, therefore, that the remedial treatment of this affection hinges largely upon a microscopic examination of the blood to determine not only the presence or absence of parasites, but also the particular variety of parasite.

As quinin is claimed by Steudel,[4] Küchel,[5] and others to distinctly benefit some cases, while, on the other hand, we have the undoubted testimony of many authorities that it does more harm than good, it will be necessary to make a careful study of the relation of this drug to hemoglobinuric fever.

Bastianelli[6] lays down the following rules as to the use of quinin in hemoglobinuric fever:

(*a*) If hemoglobinuria occurs during a malarial paroxysm and parasites are found in the blood, quinin should be given.

[1] Deaderick, Malaria, 1909, p. 333.
[2] Patrick Manson, Tropical Diseases, New York, Wm. Wood & Co., 1903.
[3] F. Plehn, Tropenhygiene, Jena, Gustav Fischer, 1902.
[4] Steudel, Die perniciose Malaria in Deutsch-Ostafrika. Leipzig, 1894.
[5] Küchel, Ueber Schwarzwasserfieber, insbesondere seine Behandlungen mit grossen chiningaben, Deut. Med. Woch., 1895.
[6] Manson, *loc. cit.*

(*b*) If parasites are not found in the blood, quinin should not be given.

(*c*) If quinin has already been given before the hemoglobinuria has appeared and no parasites are found, its use should be suspended; but if parasites persist, its use should be continued.

It is understood, of course, that if only the crescent forms of the parasites are found in the blood, quinin will be of no avail. It is only against the ameboid forms of the organism that this alkaloid is effective.

Marchiafava and Bignami believe that quinin may be useful when hemoglobinuria occurs in malarial subjects who have not taken quinin, and the development of the malarial parasites takes place in the blood in the attack or in a succession of attacks at short intervals. In such cases the disappearance of the parasite and a cessation of hemoglobinuria may follow the exhibition of quinin. It is, therefore, evident that quinin should, under no circumstances, be used in hemoglobinuria without a careful microscopic examination of the blood. The use of enormous doses of quinin has been advocated by Steudel[1] and some others, who give patients 8 and even 10 gm. per diem. This practice has few advocates. In fact, there can be little doubt, as pointed out by recent writers upon this subject, especially the German authorities, who have worked particularly with the disease on the west coast of Africa, where it seems to be more prevalent than in any other part of the world, that quinin in any amount does more harm than good. They are especially opposed to the use of large doses obstinately given by some physicians during the paroxysm.

F. Plehn[2] considers that quinin should never be used where the urine shows the presence of hemoglobin. His first rule in the treatment is to abstain from the use of quinin from the initial appearance of blood-stained urine until it has entirely regained its normal color. After the urine clears up and the attack is over, he then recommends the use of quinin in doses of ½ gr. every fifth day for six to eight weeks in order to prevent a relapse; but should symptoms reappear, quinin must at once be stopped.

It has been noted by several observers that in the blood of hemoglobinuric fever patients numerous malarial parasites may be present in the very beginning of the attack, but disappear with the appearance of the blood-stained urine, and do not reappear in the blood during the course of the attack. This is apparently due to the fact that the parasites die with the dissolution of the red corpuscles. We are indebted to F. Plehn for this observation, of such great importance to those who consider quinin unnecessary in the treatment of hemoglobinuria on account of the spontaneous death of the parasites.

We now have to consider the actual results obtained in the treatment of hemoglobinuric fever with and without the use of quinin. Scheube[3] has collected the following figures:

In Cameroon, Kohlstock, when treating blackwater fever without

[1] Steudel, *loc. cit.* [2] F. Plehn, *loc. cit.*

[3] B. Scheube, The Diseases of Warm Countries, 2d rev. ed., London, 1903, p. 165.

quinin, had no death out of 8 cases. F. Plehn had 1 death out of 25 cases = 4 per cent. A. Plehn had 5 deaths out of a total of 53 cases = 9.8 per cent. During the same period 35 cases were treated outside the hospital by other methods, therefore, doubtless, almost or mainly with quinin; of these 15 = 43 per cent. died. Döring had 5 deaths among 40 cases = 12.5 per cent. F. Plehn treated 12 cases without quinin on the Tanga Coast (German East Africa) and did not lose 1. A comparison of these figures certainly decides in favor of treatment without quinin, which, besides, is unnecessary, for blackwater fever possesses a pronounced tendency for spontaneous recovery, seeing that the malaria parasites perish during the disintegration of the blood-corpuscles.

Deaderick[1] collected from the literature 1821 cases of black-water fever treated with quinin with 472 deaths, or 25.9 per cent. In contrast to this he collected 1006 cases treated without quinin, or 11.1 per cent. deaths. This number of cases probably eliminates error and seems convincing. Such collection statistics do not exclude the use of quinin in some cases of hemoglobinuric fever, for under certain circumstances quinin may be of value. Deaderick properly concludes that it is difficult—in fact, sometimes impossible—to say whether quinin is indicated or contra-indicated in a certain case.

It is unfortunate, as F. Plehn[2] has pointed out, that the knowledge that quinin is actually dangerous in blackwater fever has made the laity in certain tropical regions afraid to use the drug in tropical malaria, which directly or indirectly during the past few years has resulted in the sacrifice of many lives.

It must be clearly remembered that while quinin may not be beneficial in the treatment of the attack, it has the same significance during convalescence from blackwater fever that it has for simple malaria, and should be used for both to prevent relapses. Those patients showing a particular idiosyncrasy to quinin, so that the hemoglobinuria appears after its administration, should leave tropical countries in order to eliminate the accumulated malarial poison from their systems.

It must also be remembered that quinin (as sulphate and muriate) is not the only drug that may bring on an attack of hemoglobinuria in malarial patients, for it has been observed to follow the administration of phenocoll, phenacetin, and also euquinin. The greatest caution must be observed in using any drug the physiologic action of which upon the blood and kidneys is not thoroughly understood, and especially those drugs which experience has shown to be harmful in this condition.

Summing up the experience of many authorities in widely separated parts of the world, the conclusion is forced upon us that symptomatic treatment is often more important than the remedial.

Deaderick believes that the only conditions in which quinin is indicated are: (1) where the parasites show no tendency to disappear after forty-eight hours from onset; (2) in the infrequent cases of intermittent hemoglobinuria where the outbreak corresponds with parasitic sporulation.

[1] Deaderick, Malaria, 1909, p. 299, etc.

[2] F. Plehn, *loc. cit.*, p. 102.

There are three prominent indications in the symptomatic treatment of hemoglobinuric fever which must be met. These symptoms are: (1) the kidney lesion, (2) the cardiac weakness, and (3) nervous conditions which are often conspicuous and painful.

Of first and greatest importance is the necessity of maintaining the action of the kidneys. For this, rest in bed, wrapping up warm in woolen blankets, and the ingestion of a large quantity of fluids (especially of carbonated waters) is, before all else, most useful. Diuresis may also be stimulated by large enemata of physiologic salt solution. The subcutaneous inoculation of large quantities of sterile salt solution is both rational and beneficial, and is especially recommended to meet the conditions found in the kidneys. In general, the uremic symptoms should be treated on the lines usually followed in acute nephritis from other causes.

Large enemata of hot water appear to do more good, according to Todd,[1] than any other form of treatment, checking vomiting and relieving the thirst, besides acting presumably reflexly as a renal stimulant.

The vomiting may sometimes be allayed by the use of cracked ice, but opiates, morphin, or tincture of iodin may become necessary. For the restlessness and vomiting it is necessary to warn against the use of drugs whose action has not been carefully determined in hemoglobinuric fever. Antipyrin, phenacetin, and phenocoll do harm. Plehn warns against the use of alcohol during the paroxysm. In distressing dyspnea he recommends the inhalation of oxygen, as recommended by Kohlstock.[2]

Convalescence is naturally prolonged, as the attack often leaves the patient in a seriously anemic and weakened condition. Owing to the state of the stomach and intestines, normal nutrition may not be established for a long time. After every attack of hemoglobinuric fever if possible the patient should change his residence to a higher climate for at least two to four weeks' convalescence while the anemic condition is being corrected. Here iron and arsenic are called for. Rest in bed and milk diet are indicated until the nephritis disappears.

Unfortunately, obstinate vomiting frequently complicates hemoglobinuric fever. which prevents taking the necessary quantity of water so important in maintaining the action of the kidneys. In these cases the use of chloroform is recommended, as it seems also to have an influence upon the nervous symptoms and causes a light and beneficial narcosis. Quennec's formula[3] for the administration of chloroform is:

℞. Chloroformi.....4 to 6 gm.
Pulveris acaciæ,
Syrupi simplicis.....āā 250 c.c.—M.
Sig.—About a tablespoonful should be taken every ten minutes until a certain degree of chloroform intoxication is produced.

[1] Charles Todd, Some Notes on the Diseases of Mashonaland, Jour. Trop. Med., Nov., 1900, pp. 92, 93. [2] Kohlstock, Deut. Med. Woch., 1891, No. 46.
[3] Quennec, Notice sur la fièvre bilieuse, hemoglob. . . . Arch. d. m. nav., 63, 1893, p. 419. Notes recueillies à l'hôpital de Nossi-Bé pendant la campagne de Madagascar, Arch. d. m. nav., 65, 1896.

In 22 successive cases treated in this manner, Quennec had no death. The value of chloroform is supposed to depend primarily upon its ability to dilate the vessels and thus relieve the congested portal venous system. Scheube states that chloroform has not fulfilled expectations.

F. Plehn advises the use of calomel and saline aperients, if anuria sets in, in order to stimulate intestinal action. Calomel is a favorite drug in hemoglobinuric fever and is used by some practitioners in very large amounts, sometimes causing salivation and other injurious effects. The physician is sometimes able by the use of cardiac stimulants to save the life of a patient when serious symptoms of cardiac depression appear. Absolute rest in bed must be insisted upon in order to guard against the cardiac weakness which so frequently accompanies hemoglobinuric fever. On the slightest sign of heart failure the use of digitalis, strophanthus, caffein, camphor with benzol, etc., are recommended. It is advisable to insist upon the patient taking his food and drink from a tube in order to save the exertion of sitting up in bed.

For the restlessness, insomnia, pain, and other nervous symptoms it will sometimes be necessary to use chloral hydrate or morphin. The use of chloroform has already been mentioned for the nervous symptoms.

Widal and Rostaine[1] obtained some very important results in the treatment of hemoglobinuria by means of serum therapy. Their object was to obtain antibodies to neutralize the action on the red blood-corpuscles of the hemolytic agent. This was accomplished by inoculating animals several times with human serum. The hemoglobinuria in the case in question was believed by Widal and Rostaine to be due to an insufficiency of antihemolytic substance which is normally present in the blood. The good results obtained in this particular case are suggestive for the treatment of malarial hemoglobinuria

BERIBERI

Beriberi seems to be a specific intoxication the cause of which is unknown. The poison has a specific predilection for the peripheral nerves. Clinically, the disease is a multiple neuritis with sensory and motor paralyses. The nervous mechanism of the heart and lungs are frequently involved. Local and general edemas are common. It occurs endemically and in epidemics in many tropical and subtropical regions. Like other communicable diseases, it has been carried aboard ships into other countries, where it has spread with fatal results.

Beriberi occurs in many portions of tropical and warm regions of Asia, Africa, Australia, and America. Small outbreaks have been known in overcrowded institutions, such as jails, in the temperate zone. Epidemics on board ships from the infected area are frequent.

In considering the morbid process of beriberi in relation to treatment, we cannot afford to neglect the evidence which has been accumulated, which makes it appear that beriberi is a nutritional disorder instead of a specific infection. In Japan the disease is believed to be associated

[1] Comptes-rend. Soc. biologie, 1905, v. 58.

with the eating of bad rice or certain kinds of fish. Beriberi has practically disappeared from the Japanese navy since the introduction of an improved diet, allowing a larger proportion of nitrogenous food and forbidding the use of fresh fish altogether; but it must not be forgotten that at the same time marked improvement in the sanitary conditions of the Japanese navy were instituted, and beriberi is well known to be closely associated with overcrowding and other insanitary conditions.

Voderman traced an apparent relationship between rice and the disease in prisoners in Java and Madura in 1895–96. He showed that the incidence of the disease was much less in those prisoners who ate rice with the pericarp than in those who ate the grain peeled, that is, with the inner husk completely removed. Grimm believes beriberi to be due to infected fish; Bradden thinks it is due to a specific organism growing on rice; Gloegner, to a plasmodium in the blood; Manson, to an intoxication from saprophytic germs; Pekelhäring and Winkler, to a bacterium in the blood which requires repeated introduction. Takaki believes the disease results from nitrogen starvation, whereas others consider it due to insufficiency of fat in the food. Hamilton Wright considers that the disease results from the infection of a bacillus found in the mucosa of the duodenum only during the early stages.

There is considerable doubt as to the period of incubation. It is variously stated to be from fifteen or thirty days to several months.

Several well-marked varieties of the disease which have a bearing on the treatment are recognized: (1) The incomplete or rudimentary form, (2) the atrophic or dry form, (3) the wet or dropsical form, (4) mixed forms, and (5) acute, pernicious, or cardiac form.

Hamilton Wright considers the disease itself to be of short duration, three to six weeks, and that the nerve lesions are sequelæ similar to post-diphtheritic paralyses. In the case of beriberi Wright designates the paralysis resulting from the nerve lesions as the "residual paralysis."

The prognosis must be guarded. The disease is fickle. The mortality in some epidemic areas is high. Cases with very serious symptoms may recover completely; mild cases often die suddenly with acute paroxysms of cardiac dyspnea. The outcome of the disease depends largely upon the ability of the patient to change his residence and improve his sanitary conditions, and partake of good wholesome food.

Treatment.—Persons residing in or visiting a beriberi region should use a wholesome diet rich in nitrogenous ingredients. The experience of Voderman in the use of unshelled rice, previously mentioned, should be borne in mind. Overcrowding and unsanitary conditions must be avoided, as their influence is undoubted. Scheube mentions especially the benefits of draining the soil, good water, clean, dry, and well-ventilated rooms.

No specific remedy for beriberi is known. The favorable influence of removing the patient from the infected region and the good effects of a change of climate to a high, healthful place has long been known. We have seen cases make a rapid recovery at Norfolk, Va., when removed

from a West Indian sugar packet on which the disease had attacked every member of the crew. The results of change of climate are usually immediate and surprisingly favorable. It is even claimed that removal from a house in which a patient is sick to a neighboring house has a favorable effect. Scheube points out that a sea voyage is as advantageous as a change of residence. The change of climate should be made as soon as possible.

While there is no specific remedial therapy for beriberi, there are several indications which, treated rationally, will greatly relieve the symptoms and may ward off fatal cardiac complications.

Saline purgatives are much used in beriberi, especially when edema is present; preference is given to the sulphate of soda or magnesium. Scheube was unable to obtain any benefit from these drugs and warns against their prolonged use, as they tend to weaken the body.

Salicylic acid and salicylates also are very popular in this disease. Bälz used salicylic acid in doses of 15 gr. four or five times a day, alternating with pilocarpin $\frac{1}{3}$ gr., and reports favorable results, even the disappearance of all symptoms of the disease in a few days. Scheube, however, failed to obtain any beneficial results from the use of these drugs.

Cardiac stimulants play an important rôle in the treatment of beriberi.

Scheube,[1] who had large clinical experience with the disease and who was the first to demonstrate the true nature of the nerve lesion, says that "*digitalis* is an indispensable drug in beriberi and has rendered me good service not only for palpitation of the heart, but for dropsy also. As a remedy for dropsy I frequently administered digitalis in conjunction with other diuretics, such as acetate of potassium, squills, and always at the same time used *strong stimulants*, such as large doses of camphor or subcutaneous injections of ether. Under this treatment I have seen even the most intense dropsy disappear, and I have never been obliged to have recourse to tapping. In patients with the acute form who, on admission to the hospital, are found to be suffering from pronounced cardiac insufficiency, this, like every other form of treatment, proved without effect. On the other hand, I am convinced that in several cases in which a rapid increase of the cardiac symptoms led to the fear of an unfavorable termination, the danger was averted by this treatment.

"In the place of digitalis, the following are also recommended, digitalin, tinct. strophanthi, caffein and its adjuncts, diuretin. Extract of belladonna sometimes also proved effective in palpitation of the heart.

"In several cases of acute beriberi threatening paralysis of the heart, Bälz found cocain, which is an excellent heart tonic, very useful. Simon (according to Manson) in such cases recommends 5 to 10 drops of a 1 per cent. solution of nitroglycerin every quarter or half-hour."

Blood-letting has a well-recognized field in the treatment of beriberi, either to prevent or relieve the cardiac paroxysms. Scheube believes this treatment was first used by Marshall, and has lately been recom-

[1] B. Scheube, The Diseases of Warm Countries, 2d ed., London, 1903, p. 221.

mended by Anderson and Bälz. Sodré[1] states that the beneficial and almost miraculous effects of blood-letting in those cases in which death is eminent has led some physicians to apply it systematically in all cases of beriberi. This practice is not to be commended and can only lead to disastrous results. Bälz draws from 300 to 400 c.c. of blood. Miura advises against putting off abstracting blood too long, but to undertake it before cardiac action has sunk too low and while the impulses of the heart's beat can still be felt. He reports excellent results from drawing 100 to 250 c.c. of blood in two or three sittings by means of cupping-glasses or leeches.

To relieve the distressing agony and restlessness of cases during the cardiac paroxysm morphin is always indicated, and its use does not seem to retard or aggravate the case in any way. Should there be pericardial effusion, the pericardium can be tapped or opened for drainage.

For the severe hyperesthesia resulting from the nerve lesions, bromids may be given or local applications of chloroform liniment or other soothing lotions. This symptom is sometimes so severe as to require morphin.

The nerve lesions themselves should be treated upon the general lines laid down for peripheral neuritis from any other cause. During the acute stage, which is probably of an inflammatory character, the nerves need rest. For the residual lesions, that is, the atrophy of the muscles and the paresis and paralysis, electric treatment, massage, carefully guarded exercise, and hydrotherapeutics serve a useful purpose. For the nerves a galvanic current should be preferred, placing the cathode peripherally to the nerves and the anode centrally. For the atrophy of the muscles use the faradic current, applied by stroking the muscles with large sponge electrodes.

"In paralysis of the diaphragm, Miura recommends faradization of the phrenics with sponge electrodes, of which one is placed over the pit of the stomach and the other behind the sternocleidomastoid muscle at the clavicle, or both may be placed on the neck; the treatment to last five to ten minutes." [2]

The diet of beriberi patients must be carefully regulated. The ingestion of large quantities of fluids is particularly advisable, especially milk and other substances which have a mild diuretic action. Rest is indicated in the severe and acute attacks, methodic exercise is beneficial in the subacute and chronic cases; care must always be taken not to overtax the heart. In the distressing cardiac crises, which are so frequently fatal, the treatment must be directed to relieving the overfull heart, especially the right side. As already mentioned, the abstraction of blood from either the median basilic or external jugular vein is at once indicated; 10 ounces (300 c.c.) may be drawn, and repeated, if indicated, in a couple of hours. A hypodermic of digitalin and strychnin, aromatic spirits of ammonia, caffein, or other cardiac stimulants should be administered. The patient may also be given inhalations of nitrite

[1] A. A. de A. Sodré, Beriberi, Twentieth Cent. Prac. Med., N. Y., 1898, xiv, pp. 469–524.
[2] B. Scheube, *loc. cit.*, p. 222.

of amyl alternating with oxygen, if obtainable, as a temporary relief to the distressing dyspnea and cyanosis. A sinapism may also be applied over the heart.

Convalescence is prolonged, and in chronic cases arsenic with iron and other tonics, in addition to generous diet, are helpful in assisting the patient to regain his strength.

MALTA FEVER

Malta fever is a specific febrile infection caused by *Micrococcus melitensis*, discovered by Bruce[1] in 1887. The fever is of an irregular, recurring, or undulating type; in a typic case it lasts for several weeks, followed by a period of a few days or weeks of a relative apyrexia, which is again followed by other febrile periods.

Clinically, Malta fever is usually characterized by profuse perspiration, constipation, frequent relapses, often accompanied by pains of a rheumatic or neuralgic character, sometimes swelling of joints or orchitis. The disease is characterized by low mortality and indefinite duration.

Malta fever smolders endemically on the island of Malta, at Gibraltar, and other places in the Mediterranean basin. At times the number of cases at one place constitutes an epidemic. Bruce believes that one attack confers a definite immunity against subsequent attacks. Strangers particularly, visiting in the endemic foci, are liable to infection. On account of the almost invariable tendency to undulations of pyrexial intensity Malta fever is often called "undulating" fever, a name proposed by Hughes. The disease is also known as Gibraltar fever, Mediterranean fever, rock fever, etc., depending upon the locality. While the disease is known to exist principally in the Mediterranean basin, there is some reason to believe that it has been overlooked in other portions of the tropical world. Recent evidence points to its occurrence in northern India, Hongkong, the Philippines, and Porto Rico. The disease has, within the past few years, been reported from all parts of the world; but as it is so difficult to differentiate Malta fever from other chronic febrile attacks, its geographic distribution and incidence in Asia, America, and other places is still a matter of doubt.

Malta fever is a general infection not unlike other specific bacteriemias, such as typhoid fever. *Micrococcus melitensis* is found especially in the spleen and also in the blood. The inoculation of pure culture of this organism into monkeys produces a prolonged febrile disease similar to Malta fever. There have been several instances of the inoculation of pure cultures into man, both intentionally and accidentally, which were followed by the characteristic symptoms of the fever after an incubation period of from five to fifteen days. Little doubt, therefore, remains that this organism is the true cause of the disease.

From the standpoint of prophylaxis it is of the first importance to determine the channel of infection by which the micrococcus enters the

[1] D. Bruce, Note on the Discovery of a Micro-organism in Malta Fever, Practitioner, London, 1887, pp. 161–170.

body. In the cases before mentioned, in which the disease was produced by inoculating pure cultures of the *Micrococcus melitensis* into man, in one instance the culture was accidentally introduced into the conjunctival sac; in the others, by subcutaneous inoculation. One case which arose in England is supposed to have been conveyed from son to father by using a clinical thermometer in the mouth immediately after its use by the patient. From experimental evidence, therefore, it would appear that the infection of Malta fever may be taken in through wounds upon the mucous membranes or by food and drink introduced into the mouth. There is no evidence that the disease is directly contagious from the sick to the well.

Recent work by the Commission for the Investigation of Mediterranean Fever points strongly to milk from goats suffering from Malta fever as the principal factor in the continuance of the disease in Malta. This commission found that the milk of over 10 per cent. of the Maltese goats examined contained *Micrococcus melitensis*. When the goats' milk supplied to the naval and military hospitals in Malta was pasteurized or changed for canned milk, the prevalence of the disease practically ceased in the hospitals.

On account of the high temperature required for the growth of the micrococcus and the length of time which elapses before colonies appear and the absence of any morphologic or cultural characteristics, the search for it outside of the body is very difficult. Bassett-Smith[1] believes that infection by means of blood-sucking insects is possible, but states that the evidence at our disposal would lead one to believe that in the presence of bad sanitation, where the disease is endemic, the infection is probably conveyed in dust by winds mostly in the hot dry months following a rain, and that it gains access to the patient through some breach on the surface, probably in the throat.

Malta fever occurs especially in both the officers and men of the British army and navy stationed at Malta and Gibraltar. All authorities recognize the influence of unfavorable hygienic conditions as an etiologic factor of the greatest importance in prophylaxis. Sex has no predisposing influence and every age is prone to attacks, but mostly between the ages of six and thirty years. In Malta the greatest incidence of the disease is in the hot dry month of July. Chilling of the surface, bodily and mental depression, etc., are quoted as incidental causes.

The morbid process is that of a general infection and is seen especially in the condition of the spleen, which is enlarged, soft, even diffluent. The blood gives the usual picture of secondary anemia. The lymphoid elements are but slightly involved, the liver is congested and the seat of cloudy swelling, the kidneys are sometimes swollen and show glomerular nephritis.

The period of incubation appears to be from a few to thirty days. The outcome of the disease is usually favorable. The low mortality (about 2 per cent.) is one of the striking features of a febrile infection

[1] P. W. Bassett-Smith, The Etiology of Mediterranean or Undulant Fever from a Naval Standpoint, Brit. Med. Jour., Aug. 13, 1904, p. 325.

which sometimes lasts for months. The average stay in the hospital is ninety days, but cases have been known to continue for a year and a half and more. Death usually results from a suddenly developed hyperpyrexia or exhaustion, with failure of the circulation and passive congestion of the lungs.

Treatment.—The prevention of the disease consists, first of all, in keeping away from the infected region during the hot unhealthful season. If duty or other circumstances do not permit such a choice, it is advisable to leave the overcrowded cities for the neighboring country.

In view of the recent work reported by the Commission for the Investigation of Mediterranean Fever it would seem that the most important factor in prophylaxis would be the pasteurization of all goats' milk used, or the use of canned milk. In addition, attention should be paid to the sanitary condition of the dwelling houses and surroundings, which includes the proper disposal of excreta, the use of pure water and clean food. It is also advisable to thoroughly screen the houses.

The disease itself defies all kinds of treatment, which is entirely symptomatic and empiric. No drug at present known has the property of modifying the power of the bacteria in the system. The disease must run its course until the cells and body juices have destroyed the micrococci and eliminated their toxic products. The principal object of treatment, therefore, is directed to keep the patient's strength up by proper rest and diet, and, when required, by stimulants, by careful nursing, and scrupulous attention to the hygiene of the sick room. Removal of the patient from the infected area does not cut short the course of the fever.

It can readily be understood that the nursing plays an important rôle in the treatment of Malta fever.[1] A trained nurse is advisable in all cases and is indispensable in severe cases, and it is especially during the night and early morning that an attendant is required in even mild cases. Patients should be kept quietly in bed during the acute stage and while the tongue remains furred or acute neuralgic symptoms combined with pyrexia are present. Many a relapse may be traced to the patient having been allowed up prematurely and injudiciously. To guard against the distressing neuralgia and rheumatic symptoms of this fever, it is advisable to wear pajamas or underclothing of thin flannel, flannelet, or other forms of woolen garments next to the skin. The use of the bed-pan should be enforced in severe cases and in the acute stages of all cases.

The teeth and gums must always be attended to, especially in severe cases with sordes, foul breath, and typhoid state. Daily sponging to keep the skin clean is essential to prevent prickly heat and sudamina. The clothing should be changed frequently after the profuse perspiration, which is one of the features of the disease. It will also require careful nursing to prevent the formation of bed-sores. The position should be

[1] Louis M. Hughes, Mediterranean, Malta, or Undulant Fever, London, 1897, 8vo. We are indebted to this valuable monograph for several practical points in the treatment of Malta fever.

changed frequently and the skin rubbed with alcohol and water or other hardening agents.

It is very important to *regulate the diet*, as there is a tendency to gastric disturbances. Though ulcers are not present in the intestines, as in typhoid fever, the mucous membrane is in a very irritable condition and the digestive functions are out of order in proportion to the severity of the pyrexia. The patient should be started with a milk diet, followed by soft, easily digested and non-irritating foods. Beef-tea, chicken broth, eggs, etc., may be added as borne by the patient. Bruce strongly recommends the use of lemonade made from fresh lemons or limes to prevent scorbutic symptoms. The general rule is to abstain from solid food while the temperature is high. Custards, soft puddings or rice, and cereals are often well borne. As soon as the fever subsides, chicken and fish may be tried, with a very gradual return to ordinary diet. Hughes recommends that solid food should be withheld in ordinary cases until there is an absence of gastric irritability and an indication of the probable cessation of acute pyrexia of a permanent nature. A clean tongue, a return of the appetite, if combined with a subnormal temperature for one or two days, followed by a normal temperature of ten days' standing, is a fairly sure sign and would justify a return to solid food in moderation.

Alcoholic stimulants are often called for to sustain the strength of the patient, which is one of the sources of danger, owing to the long enervating character of the illness. Brandy or whisky may be added to the milk in the form of milk-punch or eggnog. No general rule can be laid down as to the amount of stimulants required; the rate and character of the pulse and the condition of the tongue are the best guides to the amount needed in each particular case. Brandy, whisky, moselle, or champagne may be used. Digitalis, strychnin, and ammonia are also occasionally indicated and serve a useful purpose in sustaining the circulation and warding off the passive congestion of the lungs.

So far as drugs are concerned, Bruce believes that the majority of cases are best treated by leaving out drugs as much as possible. Quinin is often given on account of the remittent character of the fever, and is a survival of the time when Malta fever and malarial fever were confused, but it exerts no beneficial action and, if pushed, may cause harm. There is a temptation to give salicylic acid and the salicylates for swollen joints and rheumatic pains, but in this disease these drugs are quite useless.

The employment of bacterial vaccines, made from killed cultures of the specific organism, has met with some success in chronic forms of the disease. It seems to be the general opinion, however, that their use is decidedly inadvisable in acute forms of the disease.

Of the *symptomatic treatment*, the fever needs first attention, and is treated upon the same lines as in the case of typhoid fever. The coal-tar antipyretics will often depress the temperature temporarily, but it rises again quickly and no lasting or beneficial effect is produced. The fever is most successfully combated by cold sponges, wet packs, or baths. In hyperpyrexia, which is the great danger in the disease, prompt action

may be necessary to save life, and immersion of the body in a cold bath should be resorted to. It may be necessary to repeat this every three or four hours for several days. In hyperpyrexia Bruce recommends that the patient be placed at first in water at a temperature of 80° or 85° F., and this be then cooled down some fifteen or twenty degrees by placing ice in the water. At the same time, a quantity of cold water may be dashed over the patient's head from time to time. Ten minutes is about the usual time required for each immersion, during which time a little brandy should be given. The temperature in the rectum must be taken every hour, and the bath repeated as soon as the body heat rises above 103° F.

The sleeplessness at first may require attention, and bromid of ammonia or morphin may be necessary to bring about the desired result; sulphonmethane (sulphonal) and sulphonethylmethane (trional) are also useful. As a rule, this symptom soon passes off. The headache may be relieved by ice-bags or cold applications to the head. Sometimes one of the coal-tar analgesics are indicated for this symptom as well as for the lumbar pains. Joint pains are often relieved by local applications, such as painting with iodin, gently rubbing with chloroform liniment, or fomentations of lead and opium. The joints should be swathed in cotton-wool and immobilized, just as in the case of acute rheumatic fever. For the orchitis, elevation, hot fomentations, or belladonna-and-opium wash give relief.

Constipation, which usually accompanies Malta fever, may be relieved by enemata or simple aperients, such as castor oil, citrate of magnesia, or cascara sagrada; or aloin, belladonna, and strychnin, or saline waters.

When vomiting is present the greatest care has to be taken to give the patient only such food as he will be able to retain. In these cases peptonized milk is especially useful, and with it bismuth in large doses, beef juice, albumin waters, and champagne are the chief remedies. A portion of milk should be given to the patient *the first thing in the morning*.

Calomel has been very much used in Malta fever, not only to relieve constipation, but for the supposed general beneficial influence which it exerts upon the disease. Gulia writes that "it is the sovereign remedy and anchor of hope in some cases of this fever. and gives it as far as to induce slight irritation of the mouth. Marston thinks the occasional exhibition of a mercurial (calomel), combined with ipecacuanha and rhubarb or colocynth, is very useful."[1] Hughes believes that there is nothing better than a good dose of calomel combined with jalap or compound jalap powder.

The anemia, which is almost always present in Malta fever, does not seem to be influenced by the administration of iron.

In severe cases it is necessary to watch the bladder, lest retention be overlooked. Any irritability which may be present is usually removed by the administration of acetate of potash, soda-water and saline diuretics, and attention to diet.

[1] David Bruce, Observations on Malta Fever, Brit. Med. Jour., 1889, i, p. 1105.

Change of Climate.—It is now well understood that a change of climate does not shorten the course of the disease and may not always be beneficial. Bruce holds that it is not necessary to get the patient away from the infected region. Patients may recover without leaving the Island of Malta. However, it is sometimes advisable to transfer the patient as soon as practicable to a more healthy region, as the change often has a marked beneficial effect. Those who have had most experience warn against the transportation of cases in a very debilitated condition to England and the misery of a sea voyage, and to pass a long convalescence exposed to the vicissitudes of an English winter when the climatic conditions of Malta are just becoming favorable. It is sometimes advisable, therefore, not to send patients home too early, but to wait until convalescence has begun. During convalescence the patient will need strengthening food, wine, and tonics. Flannel and woolen material next to the skin and warm clothing should be worn for some months after the pyrexia has ceased, especially in cold and changeable climates, as patients are liable to attacks of neuralgic pains on exposure for a considerable period after apparent recovery.

YAWS

Yaws is a contagious disease endemic in the tropics and characterized by an eruption beginning as papules, which later become raspberry-like, by articular pains, and a chronic course.

Yaws, or frambesia, prevails in practically all tropical countries, but is especially prevalent in certain parts of Africa and the West Indies.

The disease is very contagious; it can be produced in healthy persons by the inoculation of the blood and fluid from yaws papules. Infection in nature probably takes place through the virus coming in contact with an injury of the skin; insects may also transfer the virus mechanically. Castellani has reported finding in the scrapings from yaws a very delicate spirochete, to which the name *Spirochæta pertenuis* has been given. Children are more often affected, though no age is exempt. Males are more often affected than females; occupation has no influence; all races, if exposed to the contagium, are equally liable. The incubation period is from two weeks to two months.[1] There may be prodromal symptoms, such as slight fever, nausea, pains in the limbs, etc., but the disease begins at the point of entrance of the virus[2] by the appearance of a papule, which in about two weeks heals, leaving a superficial cicatrix. After this the general eruption begins as small papules scattered over various parts of the body; they gradually increase in size until large masses are formed. As the papules enlarge the skin over them becomes thinner and finally breaks, forming ulcers, from which a whitish-yellow seropurulent discharge exudes.

The lesion may be on the mucous membranes. There may be successive crops of the eruptions. The lymph-glands throughout the body

[1] B. Scheube, The Diseases of Warm Countries, London, 1903, p. 292.
[2] J. Numa Rat, Essay on Frambesia, London, 1891.

may be enlarged. Sometimes the pain in the joints and limbs is very annoying. The general health, as a rule, is but very little affected. The course of the disease is toward recovery; patients rarely die from the disease unless suffering from some intercurrent affection.

Yaws is a chronic specific dermatitis affecting the papillary layer of the skin. It is a specific infection not unlike syphilis, and, like most of the exanthematous diseases, must run its course. The termination is usually favorable. Immunity after one attack is definite and lasting, although, contrary to syphilis, a person may be inoculated from another case with the production of a primary lesion.

Treatment.—Persons visiting or residing in the infected region should avoid irritation to the skin, practice scrupulous cleanliness, and avoid contact with yaws patients. In certain of the West Indies yaws hospitals are provided, where the patients are kept isolated and under treatment until cured. Thorough disinfection of all clothing and dwellings of yaws patients should be enforced. If the primary papule is present when the patient is seen and before the appearance of the general eruption, the patient should be given a warm bath, a good brisk purge, and isolated. If the primary sore is on the site of a previously existing ulcer, every effort should be made to hasten its healing.[1] It is not usual to see patients in this stage, as the symptoms are slight, and they rarely apply for treatment until the appearance of the nodules on many parts of the body. The articular pains and the fevers may be very severe at this time and are best treated by giving salicylate of soda and quinin; 10 gr. every four hours of the salicylate of soda and 5 gr. of quinin sulphate should be given until the pain disappears and the fever is much reduced. The appearance of the eruption should be hastened by administering warm demulcent drinks, by hot-air baths, and flannel clothing; chills and draughts should be particularly avoided, as they have a tendency to delay the appearance of the eruption. Rat thinks very highly of a mixture of carbonate of ammonia (2 gr.) with tincture of guaiacum. When the tubercles are well out, liquor arsenici et hydrarg. iodi in 5- to 10-minim doses[2] three times a day, and gradually increased, may be given. Iodid of potash, beginning with 10-gr. doses three times daily, and gradually increased, may also be given at this time. When the last tubercles to appear have matured, warm sulphur baths and calomel fumigation often give good results in hastening their healing and disappearance.

On account of the anemia some preparation of iron should be given, and for this purpose there is none better than Blaud's pills. If it is desired to give a general tonic, the elixir of phosphates of iron, quinin, and strychnin may be used. Chlorid of mercury in small doses and perchlorid of iron in larger doses are well thought of by some.

For a local application the use of crystals of copper sulphate give the best results; the tubercles should be touched with it every five days.

[1] J. Numa Rat, *loc. cit.*

[2] William T. Prout, Frambesia or Yaws, Davidson's Hygiene and Diseases of Warm Climates, London, 1893, p. 511.

When the tubercles ulcerate, the ulcers should be bathed with some antiseptic solution, preferably bichlorid of mercury, and dusted with iodoform and a protective dressing applied. For the large granulomatous-like masses Bennett [1] advises that they be rendered as clean as possible, then cocainized, and with a sharp knife shaved down to the skin, and to this raw surface nitric or carbolic acid applied and then dressed. When the yaws are on the soles of the feet they should be well soaped in warm water to soften the thick epithelium, which should then be pared away until the yaws are exposed.

TROPICAL LIVER

A condition of the unacclimated natives of the Temperate Zone residing in the tropics characterized by an acute congestion of the liver and due to the effect of the heat, overindulgence in alcohol and food, and lack of exercise.

The natives of temperate regions often, when first arriving in the tropics, persist in the mode of life to which they were accustomed at home; they are apt to take more food and drink than necessary, often use more alcohol, and are especially apt to develop a fondness for highly seasoned foods. This, combined with lack of exercise and the atonic influence of the heat, produces a temporary hyperemia of the liver, and if persisted in becomes permanent. Men, from their habits, suffer more often from tropical liver than women; children very rarely; middle-aged persons more than young adults or those of later life. Those who lead an active outdoor life and are careful of their food and drink are far less liable. A draught of cool air following a full meal is very apt to bring on an attack of hepatitis.

At the beginning of the attack the organ enlarges. This is mainly due to hyperemia, and the enlargement may be localized or general. When examined at post mortem in this stage the liver is of a deep red color and drips with blood; here and there may be seen patches of softened tissue from which exudes a serous fluid. Later these patches soften still more and finally break down, and it then only needs the presence of pyogenic organisms to produce an abscess.

The symptoms of an acute attack are usually quite severe. The attack often begins with a chill; there is loss of appetite, nausea, the tongue has a white coat, the bowels may be loose and bile stained, or constipation may be present, with but little bile in the stools. There is generally a feeling of weight and tenderness over the liver, and by percussion the liver will be found to be considerably enlarged. There is often more or less jaundice. If the condition is not arrested, it may run on to the development of liver abscess.

Treatment.—The patient should at once be given a full dose of some saline purgative. The saline waters, such as Hunyadi and Carlsbad, are much used in place of Rochelle and Epsom salts. Chlorid of ammonium, 10 to 20 gr. three or four times a day, is considered by some

[1] R. C. Bennett, Notes on Yaws in Trinidad, Jour. Trop. Med., Nov., 1900, p. 87.

especially useful. The patient should wear a flannel band around the abdomen and take regular exercise every day. Attention to the diet is most important. All alcohol should be cut off; the food should be most plain; meat only allowed once a day, and then fish or fowl in preference to beef or mutton; milk, farinaceous articles, and thin soup may be allowed. In severe attacks with fever and much pain the patient should be put to bed and the diet restricted to as great an extent as possible, saline purges given, and large hot poultices applied over the region of the liver. When the congestion from a persistence in vicious habits becomes chronic, the patient should leave the tropics and take the cure at one of the springs, such as Carlsbad, and if compelled to return to the tropics, he should avoid all alcohol, be careful of his diet, take regular exercise, and keep the bowels well opened with saline purges.

VERRUGA

Verruga Peruviana is a chronic infectious disease occurring in parts of the Peruvian Andes characterized by continued fever, anemia, and the appearance of wart-like nodules in the skin, mucous membranes, and internal organs. The disease at one time prevailed over a much larger area in Peru than now; at present it seems confined to the states of Ancachs and Lima, Peru, on the western slope of the Andes.

The cause of verruga is not known. A number of workers have described bacteria found in the nodules, but their etiologic relation has not been proved. The disease can be transmitted by the inoculation of the blood of a verruga patient. The Peruvians believe that the disease is caused by drinking or bathing in the water from the endemic districts. The virus probably gains entrance to the system through some injury of the skin. Heat and a certain amount of humidity apparently are necessary for the prevalence of the disease, which prevails at an altitude of 1500 to 10,000 feet. No age, sex, or race is immune unless the person has had a previous attack or lived for some time in the endemic area. The incubation period is from fifteen to forty days.

An attack of verruga is divided into three stages—viz., the stages of invasion, eruption, and convalescence.

Stage of Invasion.—The fever, which is a prominent symptom of this stage, is of an irregular character, sometimes of an intermittent type, and is always associated with an anemia, which is rapid and often very severe. The patient in this stage suffers greatly with pain and swelling of the joints, large and small, which may be attacked one after another; the pain is especially severe at night. In addition to the severe joint pains, there is pain and soreness of the muscles, often followed by severe cramps. The liver and spleen enlarge and are painful. This stage lasts from one to six or eight months and, except in a very fatal form of the disease in which there is no eruption, is followed by

The Stage of Eruption.—When this period begins there is a great lessening of the constitutional symptoms, except of the anemia. The eruption usually appears first on the face and extremities and spreads

over the trunk; it begins as a number of small red spots, which quickly become bright red papules; they gradually increase in size until they reach the size of a pea or larger. They may be of almost any shape and are often fungiform; they are very rich in blood-vessels and are apt to bleed. The growth also appears upon the mucous membranes and the internal organs. This stage lasts from four or six months to two years, and is followed by

The Stage of Recovery.—In this stage the eruption disappears, the general symptoms improve, and a gradual convalescence sets in.

The mortality among the natives is about 10 per cent.; it may go as high as 90 per cent.[1] The nodules are made up of cells of various kinds held together by a delicate stroma; numerous blood-vessels and cavernous spaces are present. The disease much resembles the specific granulomata and runs a definite course. Those who survive the first stage invariably recover; that is, the appearance of the general eruption is a good sign.

Treatment.—If possible, the patient should be removed from the infected region to the coast, as it has been found that the liability to severe hemorrhage is much less at the sea-coast than in the elevated region. Moreover, cold has a tendency to delay the appearance of the eruption, and until this appears the fever and pain are severe. Drugs have apparently little or no effect upon the course of the disease, but numbers have been used.[2] A decoction of maize, either given alone or with wine, is much used by the Peruvian physicians; also, a decoction of *Buttneria cordata.* Quinin, salicylic acid, salicylate of soda, iodid of potash, carbolic acid, salol, and a number of others are also recommended.

Odriozola thinks that the best treatment is a general supporting one, to put the patient in as good a condition to resist the disease as possible. For this, he advises tonics of iron, quinin, and arsenic.

If the eruption is slow in coming out, warm baths and hot drinks sometimes hasten its appearance, with a lessening of the general symptoms; but chilling of the patient must be avoided. If hemorrhage occurs, it must be treated by pressure. For the severe pain in the first stage, morphin is the most satisfactory drug.

CLIMATIC BUBO

Climatic bubo is a form of adenitis occurring in tropical countries and not due to venereal causes.

The cause of the disease is unknown, but climate undoubtedly has some etiologic relation. Cantlie[3] has recently brought forward the idea that it is a specific infection due to an "involuted" form of the *Bacillus pestis* and that it is the true pestis minor, not meaning, however,

[1] B. Scheube, The Diseases of Warm Countries, Second ed., Philadelphia, P. Blakiston, Son & Co., 1903, p. 303.

[2] Ernesto Odriozola, La maladie de Carrion ou la verruga péruvienne, Paris, 1898.

[3] James Cantlie, Climatic Bubo from which an Organism was Cultivated; the Relation of Climatic Bubo to Pestis Minor, Brit. Med. Jour., 1904, ii, p. 669.

that it is a mild form of plague, but a specific modification of the disease due to an "involuted" form of the organism.

Manson thinks the adenitis is due to the entrance of some virus which gains access through a slight wound or insect bite of the lower extremities or genitals.

The crews of warships on the eastern coast of Africa seem especially liable to be attacked. The disease also occurs on the Malay coast, in China, the West Indies, Japan, the Mediterranean, Australasia, and on the ships of the English Channel squadron.

The disease may run an afebrile course, though usually it begins with a fever of remittent type, accompanied by a swelling, usually of the inguinal glands, sometimes of the femoral, most often of one side. The glands gradually enlarge, sometimes going on to suppuration. The periglandular tissue becomes involved in some cases and the skin adherent; such cases, unless incised, frequently rupture and fistulous tracks are formed which are very slow to heal.

Treatment.—When first seen, an ice-bag applied over the groin with absolute rest in bed should be tried. If the temperature is high the patient may be sponged or small doses of phenacetin may be given. After subsidence of tenderness, an elastic compress should be applied. As soon as suppuration is detected, free incision and drainage should be done. If there is much involvement of the periglandular tissue, enucleation of all the affected glands and closure of the wound may save much time. No drug seems to have any influence upon the disease. If malarial parasites are present in the blood, quinin should be given.

ORIENTAL SORE

Oriental sore is a circumscribed, specific, ulcerating disease of the skin, endemic in certain tropical and subtropical countries, characterized by single or multiple indurated nodules, which ulcerate and finally cicatrize, leaving a depressed scar. The virus is contagious and also auto-inoculable. A certain degree of immunity is conferred.

The sore begins as a small, itching, red spot. Soon a minute papule may be felt in the center of the congested area. The epidermis over the nodule begins to desquamate; at first the scales are fine and dry, but as the process extends to the deeper layers the scales are thicker, brown, and moist. The nodules now begin to soften and the overlying epidermis finally breaks down, and a small shallow ulcer with irregular borders and perpendicular sides is formed; the base of the ulcer is usually covered with indolent granulations, which break down and are replaced.

The ulcer discharges a seropurulent fluid varying in amount and sometimes drying into a thick yellow or black scab; from under this scab the discharge may be pressed out. The process extends by the breaking down of its sharp cut edges. After a period varying from a few months to a year, healing begins, healthy granulation appears, and cicatrization commences usually in the center. The scar is at first pinkish, later yellowish, depressed, with a tendency to contract, sometimes leading to deformity.

The ulcers should be treated as aseptically as possible; after removal of the dressings, they should be thoroughly cleansed with some antiseptic solution and either some ointment or, better, dusting-powder, as boric or salicylic acid, aristol, or iodoform applied. If a scab forms, it should not be removed. The general health of the patient must be looked after carefully; good, nourishing food and tonics given, and, if possible, the patient removed from the endemic area.

The disease prevails in northern Africa, certain islands of the Mediterranean, the Crimea, Asia Minor, Syria, Arabia, Persia, the Caucasus, India, the Malay Peninsula. Juliano has reported cases in Brazil.

Hirsch states that it is more prevalent in the latter part of summer and in the autumn. All ages and both sexes are equally liable to the disease. It is more prevalent in towns and cities than in the country districts. The disease is contagious and can be produced in man as well as in certain animals by inoculation of the discharge from the ulcers. Various microörganisms have been assigned an etiologic relation to the disease by different observers. Recently Wright[1] has described bodies found in sections and smears from a case, for which he has proposed the name *Helcosoma tropicum*, which he believes to be the cause of the disease.

The period of incubation varies from one or two days to ten or twelve days when produced experimentally. The lesion is an infiltration of the skin by cells of various kinds. They are found especially around the blood-vessels, lymphatics, and sweat-glands. These cells, with the overlying epidermis, degenerate and result in the formation of the ulcer. Death rarely results. Deformities and disfigurement often result from the scars.

As the infection probably gains entrance through some break in the skin, persons living in the infected region should practice the greatest cleanliness and pay particular attention to the slightest wound. As flies and other insects probably carry the contagium, they must be guarded against.

Treatment.—In the earlier stages some authors advise excision or thorough cauterization, either by nitric acid or phenol, caustic potash, or the actual cautery. Manson thinks such measures of doubtful value and advises less severe treatment.

EPIDEMIC GANGRENOUS PROCTITIS

A disease affecting both man and some of the domestic animals, marked by a rapidly spreading ulceration of the anus and lower bowel, with bloody discharges, fever, and great prostration. The disease prevails in certain countries in the northern part of South America and in the Fiji and other islands of the south Pacific Ocean.

The only published account of this disease is by Manson,[2] from

[1] James Homer Wright, Protozoa in a Case of Tropical Ulcer ("Delhi Sore"), Jour. Med. Research, vol. x, 1903–04, illus., pp. 472–482.

[2] Patrick Manson, Tropical Diseases; a Manual of the Diseases of Warm Countries, third ed., New York, William Wood & Co., 1903, illus., p. 756.

whom this description is taken. The disease is said to be extremely contagious. It begins with an itching in the anus with a desire for frequent defecation. This stage lasts for a few days and is followed by frequent stools of mucus and blood; there is much tenesmus, fever, and the constitutional symptoms of a severe infection. The symptoms decrease in severity and the patient dies with convulsions. In children prolapse of the rectum is frequent.

The cause of the disease, which has been little studied, is not known, but natives think it is caused in children by chewing the green stalks of unripe maize.

Treatment.—A purgative, as oil, is given, followed by an enema of lemon-juice and white rum. The juice from the stalks and leaves of *Spigelia anthelmintica* is also given as an enema. A decoction from the same plant is given by the mouth.

KUBISAGARI

Kubisagari is a disease endemic in certain parts of the Island of Hondo, Japan, characterized clinically by attacks of dimness of vision, diplopia, paresis of the muscles supporting the head, the trunk, extremities, tongue, and occasionally of the masseters and muscles of deglutition. Sometimes there is depression, increase of the nasal, lacrimal, and salivary secretion. The patellar reflex may be increased. The pupil reacts to light and accommodation.

The attacks may occur several times a day, lasting from a few minutes to several hours, the patient in the interval (except occasionally a slight weakness of the ocular or cervical muscles and increase of tendon reflexes) being free from symptoms. The attacks are sometimes brought on by exertion, hunger, or dietetic indiscretions. According to Miura,[1] horse and cattle plague is very prevalent in the localities in which kubisagari prevails, and he considers that the two have some etiologic relation. The disease prevails only during the warm season, disappearing as cool weather sets in. All ages and both sexes are affected. It is not often seen among the inhabitants of cities, and then only in persons engaged in agriculture. The disease may last for years, but never has a fatal termination.

Treatment.—According to Miura, household remedies that are popular are a decoction of the leaves of cannabis sativa or of magnolia kobus D. C., and the application of a cautery or blister to the cervical and dorsal spinal region.

Nakano recommends quinin, strychnin, iodid of potash, mercury, leeches, blisters, subcutaneous injections of camphor. He obtained the best results by first administering a saline followed by quinin sulphate, 0.5 gm., powdered opium, 0.03 gm., at the same time giving a subcutaneous injection of camphor.

Gerlier[2] obtained the best results from small doses of iodid of potash.

[1] K. Miura, Ueber Kubisagari, Mittheil. aus der med. fac. der kaisl, Japan Univ., 1894–97, illus. map, pp. 259–319.

[2] Gerlier, Une épidémie de vertige paralysant, Rev. med. de la Suisse romande, 1886, vi, p. 769; 1887, vii, p. 5.

Miura used iodid of potash and arsenic combined in a number of cases with good results.

Rest in bed, full diet, and freedom from worry aid in recovery. During the intervals, general faradization, cool friction, and massage are advised.

JAPANESE RIVER FEVER

Japanese river fever is a disease endemic in the districts bordering certain rivers on the west of the Island of Hondo, characterized by a circumscribed necrosis of the skin, lymphatics, an eruption, and fever.

The disease was first described by Palm, and more fully by Bälz and Kawakami.[1]

According to Scheube,[2] the disease prevails only in the districts bordering on certain rivers on the west coast of the Island of Hondo. These rivers overflow every spring and large areas are covered with water. When the water recedes hemp is raised on the land, and it is among those engaged in the saving of this crop that the disease prevails.

The incubation period is from four days to a week. Prodromal symptoms are slight. The patient may have slight fever a few days before the actual onset of the disease. The attack is generally ushered in with repeated rigors, headache, and prostration. About the second day pain and tenderness of the lymphatics of the neck and groin, axilla, or other glandular region is noticed. Near the affected glands and within the area drained by them a small, round, dark, necrotic spot with a scab will be found. This is surrounded by a painless area of congestion; there may be two or more such necrotic spots. The nearby glands are enlarged and tender, but there is no involvement of the periglandular tissue. The other superficial glands of the body, especially on the opposite side corresponding to those most affected, are also enlarged, but to a less degree. The temperature ranges from 38° to 41° C.; the pulse is relatively slow compared with the amount of fever. Conjunctivitis is always present; spleen enlarged; urine usually contains albumin. On the sixth or seventh day large, irregular, dark red papules appear, first on the face, spreading to the forearm, legs, and trunk. At the same time small, dark red nodules are noticed on the forearm and trunk. The eruption lasts from four to seven days and does not itch. At the end of the second week the fever remits and convalescence rapidly sets in. The ulcers heal very slowly. The mortality, according to different writers, varies from 15 to 70 per cent.

All ages and both sexes where exposed are equally liable to the disease. The Japanese think the disease is due to the bite of an acarus related to the *Leptus autumnalis*, but Bälz denies this. Takari found a species of proteus in 3 autopsies which he thinks is the cause of the disease.

Treatment.—Care should be taken by those in the endemic region

[1] E. Bälz and Kawakami, Das japanische Flufs- oder Ueber-schwemmungsfieber, Virch. Arch., 1879, p. 373.

[2] B. Scheube, Diseases of Warm Countries, second ed., Phila., 1903.

to protect themselves from the bites of insects. The treatment is entirely symptomatic. For the headache and pains, morphin may be used. The fever may be controlled by coal-tar antipyretics or sponging, but Scheube states that the Japanese do not stand cold baths or as large doses of antipyretics as Europeans. The ulcers should be dressed antiseptically.

AINHUM

Ainhum is a disease occurring almost exclusively among the dark-skinned races of certain tropical and subtropical countries, and is characterized by the gradual formation of a constricting band around the base of usually the fifth and sometimes of the fourth toes, and occasionally of the fingers.

Clarke[1] published the first description of the disease in 1860. Since that time it has been reported by observers from many parts of the world.

The disease begins as a shallow constricting groove on the inner and lower side of the small toe; the corresponding toe of the opposite foot may be affected at the same or at a later time. Gradually the groove extends around the toe. The toe now swells, and has the appearance as if a wire or thread were tightly wound around it. The groove gradually deepens until, finally, the toe is connected to the foot by a thread-like pedicle, which may be severed accidentally or intentionally, and the toe drops off.

Ainhum prevails in the northern, western, and southern parts of Africa, in Brazil, the West Indies, southern United States, and in some parts of Asia. The dark-skinned races are especially liable to the disease. Males are more subject than females. The disease is not frequent after the age of thirty. Slight injuries are often the starting-point. The affection apparently has no effect upon the general health; it may last as long as fifty years or until the toe is amputated.

The relation of the affection to *leprosy* has received attention from a number of observers, but ainhum appears to be a distinct disease from leprosy.

Treatment.—When the patient refuses even the simplest operative means, some relief may be given by requiring scrupulous cleanliness of the affected toe, dusting boric acid in the groove, and the wearing of a small pad to prevent the falling down of the toe.

If the case is seen early, deep incision of the constricting bands at a right angle to the groove undoubtedly will cure many cases. Later, when the groove has become deep, amputation at the metatarsophalangeal joint should be done.

SPOTTED FEVER

Spotted fever of the Rocky Mountains is a disease occurring principally in the spring of the year in certain valleys of the Rocky Mountains, characterized by fever of a remittent type, an eruption at first macular,

[1] Clarke, Trans. Epidemiol. Soc., 1860, i, p. 105.

later becoming petechial, and with a tendency to gangrene of certain parts of the skin.

The disease occurs in certain parts of Idaho, Wyoming, Nevada, Oregon, and especially in the Bitter Root Valley of Montana. It prevails at an elevation of from 2500 to 4000 feet above sea level. It occurs almost exclusively in the spring of the year. Those whose occupation takes them into the country seem especially liable. Neither age nor sex seem to have any influence. The researches of Ricketts have shown that the cause of the disease is in the blood and that it is conveyed by means of a tick, the *Dermacenter reticulatus*. Ricketts has succeeded in finding infected ticks in nature which, when applied to guinea-pigs, produce the disease. Recently Anderson and Goldberger[1] have shown that the disease is not identical with the typhus fever of Mexico which prevails at about the same altitude. The incubation period is from three to ten days.

The attack usually begins with a distinct chill, pain in the head and back, soreness of the muscles, and aching of the long bones. The bowels are constipated, face flushed, conjunctivæ congested, later becoming jaundiced, nosebleed often is seen and frequently repeated. The temperature gradually rises with morning remissions; the pulse is relatively high. The eruption usually appears on about the third day, first on the wrist and ankles, then spreads over the body, but is more abundant on the abdomen; it is at first bright red and macular, and varies from the size of a pin-point to a split pea; about the tenth day it becomes distinctly petechial in character. The course of the disease varies from a week for the fatal cases to three or four for those that recover. The average case mortality in the Bitter Root Valley is about 70 per cent. The most prominent post-mortem appearance is a very large and soft spleen.

Treatment.—The treatment of spotted fever is almost entirely symptomatic, though there are one or two drugs that have been used in the treatment of the disease which are thought by some to have some effect on its course. The first of these is quinin; it should be given as soon as the diagnosis is made, and in large and continuous doses. On account of the irritable condition of the stomach it is best to give it hypodermically; 1 gm. of the bimuriate should be given every six hours, and as convalescence sets in the dose should be gradually decreased.

Calcium sulphate and creosote are also thought by some to do good. The bowels should be kept open with calomel, followed by a saline; an occasional enema to wash out the lower bowel often does good.

For the severe pain in the head and back nothing seems to be quite as useful as morphin; some patients appear to be able to stand enormous doses. The heart should be supported with strychnin, whisky, and if it becomes very rapid, digitalis, either as the tincture or, in case of a decrease in the excretion of urine, the infusion of digitalis combined with

[1] John F. Anderson and Joseph Goldberger, On the Relation of Rocky Mountain Spotted Fever to the Typhus Fever of Mexico; a preliminary note, Public Health Reports, December 10, 1910, vol. xxiv, p. 1861.

acetate of potash. For the fever nothing can be better than the bath; the patient should be put in with the water at about 80° F. and gradually cooled down to about 68° or 70° F., or until the rectal temperature has fallen to 102.5° F. Sponging or the wet pack may also be used if for any reason the full bath cannot be used.[1]

Milk should be the principal diet, though buttermilk, broths, soft eggs, and toast may be allowed if the fever is not running high. The patient should be encouraged to drink large quantities of water. Particular attention must be paid to the skin, especially on account of the tendency to the development of gangrene of the testicles and bed-sores on the back and buttocks; the skin should be rubbed several times a day with a saturated solution of zinc oxid in alcohol and the patient's position must be frequently changed. The mouth should be kept as clean as possible. For the often very severe nosebleed it is sometimes necessary to pack the nostrils.[2]

EPIDEMIC DROPSY

A specific epidemic disease, lasting from three to six weeks, characterized clinically by fever, nausea, diarrhea, and paresthesias, followed by sudden edema and often accompanied by a rash and profound anemia.

The first published description of the disease was by McLeod[3] of an epidemic which appeared in Calcutta in 1877–80. The disease has also been reported at Shillong, in Assam, at Dacca, at South Sylhet, and in Mauritius.

The disease usually begins by vomiting and diarrhea. Fever, often of a remittent type, usually precedes for a few days the sudden appearance of the dropsy, which appears first in the legs, and in some cases is confined to the lower limbs; in others it spreads and involves the whole body, including effusions into the serous cavities. Paresthesia of the skin and aching of the joints and muscles are sometimes present. An eruption, erythematous on the face and rubeolous on the trunk and limbs, is frequent in some epidemics. Anemia is always present and often very pronounced.

Both sexes are equally subject to the disease. Persons past the age of puberty are more liable, and it attacks the well-to-do classes as well as the ill fed and poorly nourished. The case mortality runs from 3 to 40 per cent.

Treatment.—The treatment is entirely symptomatic. Small repeated doses of saline purgatives and infusion of digitalis to remove as much fluid as possible should be tried. If the effusions into the serous cavities are large, tapping of the abdominal or pleural cavities may tide the patient over the critical period. When convalescence sets in, iron, tonics, and good nourishing food should be given.

[1] P. M. Ashburn, A Suggestion as to the Treatment of the Spotted Fever of Montana, Lancet-Clin., 1905, p. 579.

[2] John F. Anderson, Spotted Fever (Tick Fever) of the Rocky Mountains, Bull. No. 14, Hyg. Lab., United States Pub. Health and Mar.-Hosp. Serv., 1903.

[3] Trans. Epidem. Soc. London, n. s., vol. xii.

KALA-AZAR

Kala-azar is a specific infectious disease characterized by periods of fever, followed by apyrexia, a chronic course, enlargement of the liver and spleen, emaciation, and anemia.

Kala-azar, dumdum fever, or tropical splenomegaly, prevails especially in Assam and to a less extent in India. A number of different theories have been advanced as to the cause of the disease. The work of Leishmann[1] and Donovan,[2] in which they reported having found bodies in fluid from splenic puncture made on persons sick of kala-azar, and the very recent announcement by Rogers[3] of the development of trypanosomes in cultures made from the spleen of kala-azar patients, adds one more to the number of diseases due to animal parasites. The parasite is of an elliptic shape, from 1.5 to 4 μ in length by 1 to 2.5 μ in width; the smaller bodies are fusiform, while the larger are circular; there is a double nucleus. The method of transmission is not yet known, though, reasoning by analogy with malaria, it is probably some insect, either the mosquito or one of the biting flies.

The disease usually begins with high fever, with or without a rigor. This initial fever may last from two to six weeks. The liver and spleen enlarge, the latter in some cases enormously; then there is a period of apyrexia, to be followed again by fever and enlargement of the liver and spleen; this may continue for months, until finally there is continued fever. The patient becomes greatly emaciated and very anemic. The disease is very fatal; but few recover, death being due in a great many cases to some intercurrent affection.

Treatment.—Quinin is thought by Price[4] to be reliable as a prophylactic. The treatment of the disease is very unsatisfactory. Quinin may be given, especially if there is at the same time a malarial infection. Arsenic and methylene-blue have been used. Change of climate in some cases has resulted in improvement. The patient should be given a good nourishing diet, the bowels kept open, and, in short, put in as good condition as possible in the lack of a specific treatment for the disease.

TRYPANOSOMIASIS

Trypanosomiasis is an infectious disease caused by the *Trypanosoma gambiense*, characterized clinically by fever of a remittent type, localized congestion of the skin and edema, gradual wasting, and a tendency to the slow development of a lethargy ending in death.[5]

Trypanosomiasis appears, from our present data, to be confined to Africa. The disease seems to be more prevalent among the natives of

[1] W. B. Leishmann, On the Possibility of the Occurrence of Trypanosomiasis in India, Brit. Med. Jour, 1903, i, p. 1252.

[2] C. Donovan, On the Possibility of the Occurrence of Trypanosomiasis in India, Brit. Med. Jour., 1903, ii, p. 79.

[3] On the Development of Flagellated Organisms in . . . Kala-azar, Lancet, London, 1904, ii, p. 215; Quart. Jour. Micr. Soc., London, 1904–05, xlviii, pp. 367–377.

[4] Dodds Price, Indian Med. Gaz., Oct., 1901.

[5] G. R. Ruata, Trypanosomiasis in Man, Jour. Trop. Med., 1904, pp. 147, 167, 184, 198.

regions near the rivers or lakes. Those living on higher ground are almost exempt. Neither age nor sex has any influence.

The trypanosome, which is the cause of the disease, was first seen by Ford and later was described and named by Dutton;[1] they saw the parasite in the peripheral blood. Castellani,[2] studying sleeping sickness, found a trypanosome in the cerebrospinal fluid of 70 per cent. of the cases he studied. The two parasites appear to be identical, and sleeping sickness a later stage of trypanosomatic infection. Bruce[3] has been able to produce a disease in monkeys closely resembling sleeping sickness in man by the inoculation of blood and cerebrospinal fluid of persons who at that time showed no symptoms of the disease other than the parasite in the blood. The disease is transmitted by the *Glossina palpalis*, one of the tsetse flies.

The period of incubation is not known. The disease begins by a rigor, an erythematous rash on face and trunk, and high fever. The fever continues for eight or ten days and falls to normal. After a variable time there is another attack of fever and remission, and this keeps up. The pulse runs from 100 to 160. The skin shows circular patches of erythema situated on various parts of the body. The edema is more pronounced in the face, the lumbar, and sacral regions. This stage may last for years. The lethargy may come on gradually or be acute in its onset. The patient becomes easily fatigued, appears dull and listless, and has the general appearance of a person overcome by the want of sleep. The lethargy gradually deepens, the patient fails to get the proper amount of nourishment, and finally is carried off by some intercurrent affection or slowly starves to death. This stage lasts from four to ten months. The only distinct lesion at post mortem is an extensive meningo-encephalomyelitis. No case has been known to recover.

Treatment.—Quoting Ruata,[4] the principal points in the prophylaxis of this terrible disease are: "(1) to avoid tsetse-fly zones; (2) when in a tsetse-fly area the body must be protected from bites; (3) wire gauze nets should be applied to every opening of the dwelling houses in the infected areas; (4) extermination of these very dangerous diptera, and, when it is possible, suppression of the conditions favorable to this disease; (5) isolation of the patients or their removal from the tsetse-fly country to prevent their infecting others."

Laveran[5] has, in view of some good results obtained in the treatment of animals infected with *Trypanosoma gambiense* by arsenious acid and trypanroth, recommended the combined use of these two drugs in the treatment of human trypanosomiasis, especially the early stage. Chrysoidin has also been suggested. Thomas[6] reports good results from

[1] J. E. Dutton, J. L. Todd, and Cuthbert Christy, Trypanosomiasis, Liverpool School Trop. Med. Reports, 1903–04.

[2] A. Castellani, Sleeping Sickness, Lancet, 1903, i, pp. 723–725, Brit. Med. Jour., 1904, ii, p. 71.

[3] Bruce, Reports of Sleeping Sickness, Roy. Soc., No. 4, 1903.

[4] G. R. Ruata, *loc. cit.*

[5] A. Laveran, Compt.-rend. acad. d. sc., v. 140 (5), pp. 287–291.

[6] H. W. Thomas, Some Experiments in the Treatment of Trypanosomiasis, Brit. Med. Jour., 1905, i, p. 1140.

the use of trypan red and arsenic in a human case; he advises the administration of high doses intravenously and for a long period, pushing them so as not to produce nausea and headache, and to use other measures to keep the patient in as good general condition as possible.

Of the new arsenical compounds, atoxyl, soamin, and arsacetin are perhaps the most important. A few words on these drugs and their methods of use may be of value.[1]

"Atoxyl and soamin are both trade names and are forms of sodium arsanilate containing, respectively, about 26 per cent. and 22 per cent. of arsenic. They are sold in the form of the salt itself and in the form of hypodermic tablets.

"Sodium arsanilate is prepared by condensing aniline and arsenic acid, eliminating water and isolating the arsanilic acids. The sodium salt is prepared by the usual methods.

"It occurs as white, odorless crystals soluble in 5 or 6 parts of water and more soluble in warm water.

"*Action.*—The arsenic of the arsanilic acid is liberated very slowly in the system, thus producing the ordinary therapeutic effects of arsenic with the advantage of a more continuous and less toxic action and less irritation. Toxic effects from excessive doses have been frequently noted, although the toxicity is stated to be about one-fortieth of that of arsenic trioxid. The use in large doses has occasionally resulted in blindness from degeneration of the optic nerve.

"*Dose.*—0.02 to 0.2 gm. ($\frac{1}{3}$ to 3 gr.) hypodermically, every other day, gradually increasing if necessary until the single dose reaches 0.65 gm. (10 gr.) and until a total of 6.5 gm. (100 gr.) have been given. The drug should not be given by mouth, as it is decomposed by the acid of the stomach and toxic symptoms may result.

"Arsacetin is sodium acetyl arsanilate. Its action is the same as sodium arsanilate. It is much more soluble and withstands heating, so that its solutions may be sterilized. The dose is, hypodermically, 0.1 to 0.5 gm. ($1\frac{1}{2}$–$7\frac{1}{2}$ gr.), internally 0.05 gm. ($\frac{3}{4}$ gr.) three or four times daily. If energetic action is required, two injections a week of 0.6 gm. (9 gr.) each, given on successive days, should be continued till twenty injections have been given. (This brief account of these remedies is abstracted from the Jour. Amer. Med. Assoc., 1909, vol. lii, p. 2106.)

"Koch, in his extensive experience with atoxyl in trypanosomiasis, after getting several cases of blindness, concluded that the safest and most efficient dosage hypodermically was 0.5 gm. ($7\frac{1}{2}$ gr.) on each of two succeeding days, and with intervals of ten days between; this double treatment is repeated for many months. By mouth Koch found that a dose of 0.5 gm. ($7\frac{1}{2}$ gr.) is insufficient, while larger doses produced toxic symptoms, and he had no success with the drug given in this way."[2]

[1] C. H. Lavinder, Notes on the Prognosis and Treatment of Pellagra, Public Health Reports, September 10, 1909, vol. xxiv.

[2] Terry, Arch. Int. Med., vol. 3, p. 2.

RELAPSING FEVER

Relapsing fever is a specific infectious disease due to the Spirochæta of Obermeier, characterized clinically by a febrile paroxysm lasting about six days and followed by a remission of the same number of days, which cycle may be repeated three or more times.

The disease was formerly endemic in certain parts of England and Ireland,[1] but is rare now. It prevails at times throughout the greater part of Europe, the northern part being particularly affected. In Asia it has prevailed epidemically in certain parts of India, notably Bombay. Cases have been reported from Egypt. The last appearance of the disease in the United States was in 1869.

The predisposing causes of relapsing fever are very similar to those of typhus fever. Overcrowding and lack of sufficient food and other unsanitary conditions seem to favor its spread; starvation, as in a time of famine, especially promotes its prevalence.[2] The infection appears to be transmitted directly from the sick to the well and may be harbored in fomites. It is more prevalent in the winter; males more often than females are attacked, but the mortality is greater among women than men; the greater number of cases occur between the ages of ten and twenty-five years.

The disease is caused by spirochætæ which are found in the blood during the fever. They are probably transmitted by the bed-bug and the body louse, and are certainly transmitted by at least two species of ticks, *Argus persicus* and *Ornithodoros moubata*. Dutton and Todd, working with African relapsing fever, have found that the young hatched from the eggs of infected ticks are able to convey the disease. It seems probable that there is more than one form of relapsing fever, due to different species of spirochætæ.

The incubation period seems to be from five to ten days. The attack usually begins suddenly with rigors or slight shiverings, with intense headache and backache, the temperature rises rapidly, and in a few hours may have reached 105° F. or more, and the pulse 120 to 140 a minute. The liver and spleen are enlarged and there is tenderness over the splenic and hepatic regions. At the end of seven days, sometimes three or four, the attack suddenly ends by crisis, and in a few hours the temperature falls to subnormal and the pulse below 80, and in a few days the patient may feel as well as usual. In about seven days from the crisis the attack is repeated, and this cycle may occur three or four times. During the febrile stage the spirochæta is invariably found in the peripheral blood.

There are no characteristic post-mortem appearances. If death occurs during an attack, the spleen is greatly enlarged and softened, and may contain infarcts or small abscesses. The liver is not enlarged. The mortality varies from 4 to 15 per cent. in different epidemics.

[1] Frank G. Clemow, The Geography of Disease, Cambridge, 1903, p. 367.

[2] E. W. Goodall and J. W. Washburn, A Manual of Infectious Diseases, London, 1896, p. 279.

Treatment.—Relapsing fever appears to be as contagious as typhus fever when in epidemic form, especially to those coming into close contact with the sick, such as doctors and nurses. The sick should be carefully isolated and the house from which they are removed disinfected; for this purpose, in view of the possible transmission of the disease by insects, sulphur is probably the best disinfectant to use. In view of Schaudinn's work, prophylactic measures should include especially the destruction of bedbugs. In warm weather the cases can be treated in tents.

The treatment of the disease is entirely symptomatic, though there is a number of drugs which have been claimed by their exponents to exert a favorable influence upon the course of the disease.[1] Quinin in solution, 10 gr. three times a day, seems in some cases to exert a favorable influence in preventing relapse, but fails to cut short an attack after it has once begun. Oks[2] used calomel 4 gr. every three hours in treating the disease, and claimed that in 60 per cent. of his cases there was no instance of relapse, the attack being limited to one paroxysm; he thought that the calomel exercised a specific action on the spirochætæ. Arsenic in the form of Fowler's solution and methylene-blue have also been used; iodid of potash in full doses has been used with favorable results in some cases. Motchoutkovsky advises restricting the taking of fluids by the patient and the internal administration of jaborandi with the wet pack to induce as profuse sweating as possible; he claims that by this method the number of spirochætæ in the blood is greatly diminished and that the febrile stage was much shortened.

The above are the drugs which have been most used in the treatment of the disease, but as none of them can be said to very markedly influence the course of the disease, the case should be treated symptomatically. The patient should be isolated and placed in a well-ventilated, screened room. Unless the temperature is high, a more liberal diet than in typhoid fever may be allowed; beef-tea, chicken broth, milk, soft-boiled eggs, soft toast, and a little scraped beef may be allowed, but milk should be the main article given. As much cold water as desired should be given; lemonade is often very grateful to the patient.

The temperature in relapsing fever often goes to 106° and 107° F.; for reduction of the temperature and relief of the severe headache, nothing seems to be quite so good as the cold bath; give whenever the fever goes to 103° F. or over. Sponging, when well done and the fever is not very high, may be used. One of the antipyretics may be used in patients in whom there are no signs of heart weakness, and for this purpose quinin sulphate is perhaps the best.

Heart failure in relapsing fever is common, especially in the relapse, and should be guarded against by giving strychnin, digitalis, caffein, and wine or whisky.

For the diarrhea a brisk purge, followed by bismuth and salol, either

[1] Leo Popoff, Relapsing Fever, Twentieth Cent. Prac. of Med., New York, 1899, vol. xvi, pp. 455–548.

[2] Vratch Oks, 1881, Deut. Arch. f. Klin. Med., xxx, 1882.

with or without opium, may be used. The severe pains in the head are best relieved by the ice-cap or morphin.

When convalescence begins, the patient should be put on a tonic containing iron; given good nourishing diet and kept out of doors as much as possible, and removed from the infected region.

ULCERATING GRANULOMA OF THE PUDENDA

An ulcerating granuloma, usually affecting the genitals and neighboring parts, characterized by its granular appearance, large extent, and chronic course.

The first published descriptions of the disease were by Conyers and Daniels,[1] who studied the disease in British Guiana. Since this report cases have been reported from some of the Pacific Islands, the East Indies, Australia, China, and New Guinea.

The disease begins usually on the genitals as a small, cricumscribed, nodular thickening of the skin covered with a thin layer of epithelium; this is readily rubbed off, leaving exposed the granulation, which bleeds very easily. It extends by contiguity and, as it is auto-inoculable by the secretion, infects nearby parts. After some time cicatrization takes place in the center or at one side. There is in some cases a profuse watery discharge, in others it is scanty. The neighboring lymph-glands do not appear to be involved. There is but little impairment of the general health. The process may last for years. The disease is not seen before puberty. Both sexes and all races seem to be equally liable to the infection.

Treatment.—The disease does not respond well to any form of treatment and shows a great tendency to recur in the scars. Scraping, the application of caustics, and the actual cautery have been used. Manson suggests complete excision of the entire mass before it has assumed large proportions; he also suggests that radiotherapy may be of some use. Conyers and Daniels used camphor and carbolic acid in equal parts, and salicylic acid in creosote ointment. Daniels advises large doses of iodid of potash.

HILL DIARRHEA

An acute morning diarrhea accompanied with marked flatulence and the passage of large, pale, frothy stools, affecting principally Europeans who leave the plains and go to the higher country in certain tropical regions.

Hill diarrhea prevails especially in India, though Crombie believes it may occur anywhere under the same conditions, at an elevation of 6000 feet or more, with a higher degree of humidity.

Soon after reaching the hills the patient, who otherwise seems to be well, has a diarrhea coming on each day from 3 to 5 o'clock in the morning and lasting until about 11 A. M.; during this time he may have from

[1] J. H. Conyers and C. W. Daniels, The Lupoid Form of the So-called "Groin Ulceration" of this Colony, Brit. Guiana Med. Ann., 1896, viii, p. 13.

one to eight movements, attended by little or no pain. The stools are large, liquid, frothy, almost white, and look not unlike whitewash. There is usually a large amount of flatulence. After 11 A. M. in the general run of cases the movements cease, but return at the usual hour the next morning. These are the most frequent cases; but other persons, soon after reaching the hills, only suffer with flatulent dyspepsia, which disappears when they become acclimated. Others on reaching the hills have movements entirely free of bile-pigment, accompanied by a large amount of flatulence, but no diarrhea.

There seems to be no connection with the water or food supply. High humidity at an elevation of about 6000 feet seems to be in some way connected with the onset of the disease. It does not, however, become epidemic until the approach of the monsoon, and with the onset of the rain the number of cases increases rapidly. Crombie[1] thinks that the disease is not a dirarrhea due to inflammatory conditions, but an indigestion due to the imperfect secretion of the digestive ferments by the liver, pancreas, and bowels. Children are almost entirely exempt.

The tendency in most cases is for an early recovery. Some cases persist and end in typical sprue. Many cases only recover on returning to the plains.

Treatment.—Crombie, in discussing the treatment, says, first, that elevation, being the principal factor in causing the disease, all that is necessary is to return to the plains. In such cases this will cause a cessation of all symptoms in twenty-four hours; second, the epidemic, being closely affected by the onset of the monsoons, those liable to the disease should leave the high regions at the onset of the rainy season.

In the treatment of those who cannot leave the higher altitude, an attempt should be made to supply the deficiency in digestive ferments. For this purpose pepsin, ingluvin, or pancreatin should be given. One of the most satisfactory ways of administering pepsin is as peptonized milk. Other cases do well with the administration of 10 to 15 gr. of pepsin or ingluvin about two hours after feeding. Bichlorid of mercury is an important aid in the treatment, from $\frac{1}{20}$ to $\frac{1}{60}$ gr. well diluted before each meal. The patient should be strictly confined to a milk diet. A flannel band should be worn around the abdomen and sudden cooling off should be avoided.

NASHA FEVER

Nasha fever is a disease characterized by fever and hyperemia of the nasal mucous membrane. This disease was first reported by Fernandez and Mitral[2] in 1895. It has not been reported elsewhere than in India and prevails especially in Bengal.

For several days preceding the fever there is a peculiar congestion of the nasal mucous membrane; this may be confined to one side or both may be involved. The mucous membrane appears raised, is red, and

[1] Crombie, Ind. Med. Gaz., 1892, p. 129.
[2] Lancet, 1895, p. 69; Trans. First Ind. Med. Cong., 1895.

has a puffed-up appearance. The fever, which is preceded by a severe rigor, lasts from three to five days and is usually remittent in character. The swelling of the mucous membrane decreases as the temperature falls. Constipation is marked. Often pain in the back of the neck and shoulders. The disease is more frequent in the warm months. Males are affected more often than females. Persons over fifty and children are not attacked. Certain foods, as stale rice, seem to have a predisposing influence.

Treatment.—Fernandez advises the prompt administration of a saline. Spraying the nostrils with cold or iced water several times a day gives some relief. Puncturing the mucous membrane, with the use of astringents, as silver nitrate, etc., has sometimes given good results. The fever should be controlled by cold baths and sponging. For the pains, morphin or opium is sometimes necessary.

PONOS

Ponos is an endemic, chronic disease of young children, characterized by fever, an enlarged and painful spleen, and usually ending in death.

Ponos seems to be confined to the islands of Spezzia and Hydra in the Ægean Sea.[1] The attack begins suddenly with fever. The child is languid, yellowish, and has disorders of digestion. The spleen gradually enlarges until it may occupy almost all of the abdominal cavity; is the seat of pain, and is usually tender on pressure. The child gradually becomes emaciated, bronchitis, pneumonia, diarrhea, dysentry, and meningitis are complications. After a time ascites, with edema of the face and limbs, appear. The disease may run from a few months to one or two years. Recovery is rare.

The cause of the disease is unknown. Neither season, social condition, nor food seem to have any relation. Males are more often attacked than females. Children over four years old are rarely attacked. Children in a family with a tubercular history are especially liable.

Treatment.—Particular attention should be paid to the food; a full, nourishing diet given; if an infant and nursed by its mother, especially if she is tuberculous, a wet nurse should be employed or the baby be weaned. Quinin in small doses may be given. A change of residence might be of benefit.

TROPICAL SLOUGHING PHAGEDENA

A rapidly spreading gangrene of the skin and underlying tissues, starting from a slight injury, and occurring in persons of lowered vitality living within the tropics.

Tropical phagedena is common in almost all tropical countries. In certain places it is so prevalent that it has received the name of those places, such as "Cochin China ulcer," "Yemen ulcer," etc. Scheube[2] thinks that similar ulcers occurring outside of the tropics are identical

[1] B. Scheube, Diseases of Warm Countries, Phila., Blakiston, 1903, illus., 594 pages.
[2] B. Scheube, *loc. cit.*

with tropical phagedena. A slight injury to the skin, usually on the lower extremities, is often the starting-point; or, the disease may begin as one or more blisters, which break in a few hours, leaving an ulcer. The ulcer rapidly extends in all directions, has irregular undermined edges, and is covered with a greenish-yellow and very offensive pus. The process extends through the underlying fascia and muscle down to the bone. Sometimes blood-vessels are destroyed, resulting in severe hemorrhage, joints opened, and bones detached. In some cases the process continues to extend; the pain is excessive; septic fever sets in and the patient dies from septicemia. More often after a variable time the process suddenly ceases to extend, the slough is cast off, and healthy granulation appears and healing occurs, or the phagedena is changed into an ordinary chronic ulcer.

There can be no doubt that bacteria are the cause of phagedena, but whether due to a specific one or by a number of different ones has not been determined. Persons of a lowered vitality from overwork, underfeeding, or disease are especially prone to the disease; in such persons a slight injury to the skin, as by an insect bite, rubbing of the shoes, etc., or a yaws papule may be the starting-point.

Treatment.—A patient with tropical phagedena should be isolated. The general condition of the patient should be looked after; if malaria, syphilis, or other disease is present, appropriate treatment with tonics and good nourishing food should be given.

The ulcer should be thoroughly scraped out with the curet. This must be done thoroughly, down to the sound tissue, or the actual cautery or some caustic, as nitric acid, chlorid of zinc, etc., may be used. After this, the ulcer should be dusted with iodoform, boric acid, or aristol. Manson says he has had good results from the use of pure carbolic acid applied with a swab, followed by continuous irrigation with a warm, weak antiseptic solution. Fontan[1] advises the application of 5 per cent. carbolic acid solution once or twice daily for one or two hours, followed by boric acid ointment.

After healthy granulation appears, instead of skin-grafting Plehn[2] advises that the skin on either side of the ulcer be loosened and brought together over the ulcer. If the phagedena cannot be arrested, the question of amputation must be considered, which, if done, must be in sound tissue above the edge of the ulcer.

MYCETOMA

A disease of certain tropical and subtropical countries, and particularly of India, affecting chiefly the extremities and usually the feet, characterized by enlargement of the part, the formation of cysts and sinuses with openings through the skin from which exudes a purulent discharge containing grain-like particles either gray or black.

Madura foot, or mycetoma, is endemic in certain parts of India,

[1] J. Fontan, Traitement des ulcéres phagédéniques des pas chauds par les pulvérisations antiseptiques, Arch. de méd. náv, 1888, No. 8, p. 121.

[2] F. Plehn, Die Kamerun-Küste, Berlin, 1898, p. 284.

particularly in the Madras Presidency, to a less extent in Bombay and Bengal Presidencies. Cases have been reported from North and South America, Africa, and Europe.

The disease begins in one of the feet, occasionally the hands, and rarely some other parts of the body, by the formation of one or more hard, painless nodules in the subcutaneous tissue. After a time they soften and break down with an opening through the skin, from which exudes a white or yellowish syrupy or oily discharge, sometimes streaked with blood, and containing small grain-like particles. These particles, which are made up of the filaments of the streptothrix, are sometimes grayish or yellowish (white variety) and sometimes black (black variety). New nodules continue to form and break down and are connected by sinuses. The shape of the part is greatly changed and the surface has numbers of nodular projections on it. There is usually but little pain.

The disease is steadily progressive, and unless the part is amputated the patient finally dies from exhaustion or some intercurrent affection.

On making a section through the diseased tissue, it will be found that all of the tissues, including muscle and bones, are changed into a jelly-like mass; numerous cysts and sinuses are encountered. The cysts are filled with the discharge which exudes from the fistulous opening and are crowded with the grain-like particles, either grayish or black.

Madura foot is more often seen in men than in women, most frequently between the ages of twenty and forty-five years. Race apparently has no influence. The inhabitants of country districts are more often affected than those of cities.

Until inoculation has been made into human beings of the fungus cultivated from Madura foot, it cannot be absolutely said that it is the cause of the disease; the evidence is very strong and most investigators of the disease believe it is. The question whether the white and black varieties of the fungus are the same or different species has received much attention, with the opinion inclining to the view that they are different.[1]

The destruction of tissue in mycetoma is evidently caused by the presence of *Streptothrix maduræ*, and the object of treatment is, therefore, to destroy this fungus. Heretofore it has resisted the application of the ordinary germicides, and, therefore, is similar to malignant growths, which must be removed surgically.

Treatment.—Medicines are of no use in the treatment of Madura foot, and, therefore, the surgeon should be called in as soon as the diagnosis is made. Before the disease has made much headway, excision of the nodules, cauterization, or injection of iodoform emulsion may be tried. If the disease has involved much of the foot, amputation should be done far enough above the process to be sure that sound tissue has been reached and that the bones are not involved at the line of amputation, for often it will be found that the bones of the leg are diseased. Amputation through sound tissue gives a good prognosis, but if any of the diseased parts are left, it will recur.

[1] J. E. Bocarro, Mycetoma, Ind. Lancet, 1897, x, p. 318.

SPRUE

Sprue is a chronic catarrhal inflammation of the alimentary tract from the mouth to the anus, characterized by soreness and tenderness of the mouth and tongue, diarrhea of a peculiar character, and a decrease or entire loss in the elaboration of the digestive fluids.

This is one of the most important diseases that the practitioner in the tropics has to deal with. The disease is probably found in all tropical and subtropical lands, but it is especially prevalent in southern Asia and the neighboring islands. It is very prevalent in the Philippines and especially in the city of Manila. The first published account of sprue was by Hillary[1] in 1776, who described the disease as seen in the West Indies.

The cause of sprue is not known, but climatic influences undoubtedly play an important part; just what particular tropical influence is most important it is impossible to say. The disease is most prevalent and runs a more rapid course in those countries with continued high temperature and relatively high humidity. Prolonged stays in the tropics, exhausting diseases, especially dysentery, miscarriage, syphilis, malaria, etc., are important predisposing causes. The *Anguilla stercoralis* at one time was thought to be the cause of the disease.[2] It is often found in the stools of persons not suffering with the disease, and also is frequently absent in those of sprue patients. Cantlie[3] believes that sprue is caused by the food, particularly certain vegetable oils, much in favor among eastern cooks, in persons on whom prolonged residence in the tropics has rendered less resistent. Persons from thirty-five to sixty are more liable to be attacked; women more than men.

The patient usually seeks relief for the sore mouth, but the mouth symptoms are always preceded by gastric and intestinal indigestion accompanied by eructation of gas and acid liquid, morning diarrhea with large frothy stools. Small raised red spots appear on the tongue and gradually spread over the entire surface and on to the whole buccal mucous membrane until the entire visible surface appears to be stripped of its mucous coat. The tongue becomes narrow and pointed and can be extruded only with great pain. The organ is very sensitive and at the least attempt to take any but the blandest kind of food the pain and burning is almost unbearable. The accumulation of gas in the stomach and intestines is at times tremendous.

The diarrhea in a typical case is almost specific. The patient has a call to stool early in the morning and up to 11 o'clock may have from three to eight movements; they are pale, almost white, sometimes fluid, but more often frothy and exceedingly large in amount. The consistency of the stools varies with the condition of the alimentary tract. During an acute attack, when the mouth is red and inflamed, they are fluid; as

[1] Hillary, Beobachtungen über die Krankheiten auf Barbadoes, U. S. W. A. d. England, Leipzig, 1776, p. 328.

[2] A. Normand, Mémoire sur la diarrhoée de Coalimatino (?), Arch. de méd. nav., 1877, Jan., p. 35, Feb,, p. 102.

[3] J. Cantlie, Sprue: Symptoms, Etiology, Post-mortem Appearances, and Treatment, Practitioner, London, 1898, lxi, pp. 580–589.

the acute attack wears off, they become frothy and bulky. There is no tenesmus.

When the disease has lasted some time it will be found that the liver has decreased in size considerably. In the beginning the temperature runs from 99° to 102° F.; after the disease has become chronic it usually remains subnormal, except during the acute exacerbation. The disease may last from one or two years to ten or fifteen. The prognosis is bad in persons over fifty, in those who will not submit to treatment, and those who have lived a long time in the tropics. At autopsy the appearances are generally those of starvation: pronounced emaciation, all the organs appear smaller, the stomach and intestines are thin and white, and the epithelial covering in many places is gone, the liver is small, pale, and sometimes cirrhotic.

Our conception of the morbid process in sprue is that it is an inflammation and destruction of the alimentary mucosa, resulting from a combination of dietetic and climatic causes. It is evidently not a disease due to specific infection. The rational treatment, therefore, is absolute rest to the inflamed mucosa followed by the careful supervision of the diet. No treatment can restore the destroyed mucosa, which emphasizes the importance of early and thorough treatment.

Treatment.—The treatment of sprue is largely dietetic. An exclusive milk diet seems to be the one most generally advised, though no less an authority than Cantlie condemns it most severely.

As soon as the patient is seen, he should be put to bed and some purgative administered,[1] preferably castor oil or compound rhubarb powders; until the purgative acts no food should be allowed. After the bowel has been well cleaned out the milk diet must be begun; begin by allowing 4 to 6 ounces every two hours, so that about 60 ounces are taken in the twenty-four hours. If the patient is very weak the feeding must be kept up night and day. Manson and other authorities state that the food must not be drunk, but either sipped from a spoon, or through a fine tube, or taken from a nursing bottle. The milk may be taken either hot or cold; sometimes it may be found advisable to add lime-water or soda-water to it. Usually after a few days of this diet the stools will become less fluid, the flatulency less severe, and the mouth not so sensitive.

The amount of milk is now gradually increased, but no other food should be allowed until at least six weeks after the stools become solid and the mouth symptoms have disappeared. After the second or third week the patient may be allowed to get up and, if the weather is suitable, go out. The diet may now be gradually increased by first allowing a raw egg, then a well-cooked farinaceous food, chicken broth and meat juice, scraped beef, chicken, fish, etc. On the first appearance of the return of any of the symptoms the patient should be promptly put to bed and the milk diet, as in the beginning, begun; there should be no delay, as to do so endangers the life of your patient.

[1] P. Manson, Tropical Diseases, third ed., New York, Wm. Wood & Co., 1903, p. 425.

Some patients, unfortunately, do not do well on or are unable to take a milk diet; they may be given raw meat juice made from the fresh meat, and as improvement takes place, scraped meat, rare beef, etc., may be gradually allowed. The use of some fruits, as strawberries, peaches, apples, grapes, etc., is claimed by some to be of great benefit.[1]

Some drugs undoubtedly are of value in the treatment of the disease. Brunton[2] speaks with great favor of bismuth combined with tincture of cannabis indica. Begg[3] reports good results from the use of yellow santonin; he gives a good dose of castor oil to start with and 5 gr. of yellow santonin in sweet oil twice a day for a week. The administration of 5 minims of cyllin[4] in capsules which are not dissolved in the stomach has lately been brought forward as useful; this dose is given every three hours. Manson reports good results from the intramuscular injection of very small doses of arseniate of iron. The patient should be warmly clothed, always wear an abdominal band, and avoid getting damp or chilled, and fatigued. As soon as possible he should return to a more temperate climate, but avoid arriving there when the weather is damp and cold.

The mouth should be washed with a weak chlorate of potash, borax, or bicarbonate of soda solution. For the soreness of the anus, oxid of zinc or bismuth ointment is useful.

[1] Edward H. Young, Treatment of a Formidable Case of Sprue by Diet; the Value of Strawberries, Lancet, London, March 28, 1903; B. Scheube, *loc. cit.*, p. 459.

[2] Sir L. Brunton, Sprue; Edinburgh Med. Jour., 1900, vii, p. 105.

[3] C. Begg, Santonin in Sprue, Lancet, 1898, p. 185.

[4] William Hartigan, The Use of Cyllin in Sprue, Jour. Trop. Med., March 1, 1905, p. 65.

THE OCULAR COMPLICATIONS OF THE INFECTIOUS DISEASES

By G. E. de Schweinitz, M. D.

The ocular complications of the infectious diseases are of frequent occurrence, and include diseased processes in the various coats of the eye and the ocular adnexa. For convenience the subject-matter is arranged as follows:

(1) A brief description of the important diseases of the eye which have been observed in infectious diseases; (2) the treatment applicable to these affections, no matter with which one of the infections they may be associated; (3) special lines of treatment under special conditions.

Typhoid Fever.—In typhoid fever there may occur (1) affections of the conjunctiva and of the cornea; (2) affections of the uveal tract—iris, ciliary body, choroid—and of the vitreous humor; (3) affections of the crystalline lens; (4) affections of the optic nerve, retina, and retinal vessels; (5) affections of the orbit and orbital circulation; (6) affections of the exterior and interior ocular muscles.

If feebleness of accommodation as part of a postfebrile weakness is excepted, it is probable that affections of the conjunctiva and cornea are the most frequent ocular complications, and, in so far as the conjunctiva is concerned, may appear as an ordinary conjunctivitis, or, especially in the convalescent period, as a phlyctenular conjunctivitis. These phlyctenules may be the starting-point of an ulcerative keratitis or an infected ulcer of the cornea; a sloughing keratitis may arise without such antecedent conditions, especially in the fourth week of the disease, and presents a prognosis in aggravated cases which is of serious import.

Iritis, cyclitis, and choroiditis, representing, therefore, affections of the uveal tract, are occasionally encountered during typhoid fever, especially in the convalescent period, and fine opacities in the vitreous are probably not uncommon. A purulent choroiditis, or a metastatic ophthalmitis, exactly as it is seen in sepsis, may arise.[1]

Interference with the nutrition of the uveal tract may be followed by cataract; double soft cataracts and so-called punctate cataracts in young subjects have been attributed to typhoid fever.

Optic neuritis has been described, although many authors are unwilling to admit its existence in the absence of meningitis. It would seem,

[1] See Ocular Complications of Typhoid Fever, by G. E. de Schweinitz, in Surgical Complications and Sequels of Typhoid Fever, by W. W. Keen.

however, that certain well authenticated cases, even of the bilateral variety of the disease, have been observed.[1]

As the result of a neuritis, optic nerve atrophy may occur, and constitute, therefore, a posttyphoidal phenomenon, while the intestinal hemorrhages of typhoid fever have been known to cause atrophy of the optic nerve.

Instead of an intraocular optic neuritis, retrobulbar neuritis may arise, as well as amblyopia without ophthalmoscopic changes, such as occurs in uremia and scarlet fever.

It is probable that retinal hemorrhages at the height of typhoid fever are more common than the records indicate, and depend upon degenerative changes in the vessel walls, upon an altered condition of the blood itself, or even upon a microbic invasion of the vascular walls. In rare instances embolism of the retinal vessels, even of the central artery, has occurred. Spontaneous hemorrhage into the orbit, thrombosis of the orbital veins, and orbital cellulitis are occasional complications of typhoid fever.

Paresis of accommodation is exceedingly common, and particularly noteworthy during the period of convalescence. Should there be intracranial complications during the height of the disease, there may be palsies of the exterior ocular muscles—ptosis, abducens and trochlear paralysis—and, as I have reported, paralysis of the oculomotor.

Typhus Fever.—The ocular complications are comparatively infrequent, but the following have been described[2]: conjunctivitis, iritis, keratitis, vitreous opacities (not uncommon), retinitis, and optic neuritis. So, also, complete destruction of the eye from metastatic ophthalmitis has been observed. These affections may occur during the fever, during relapses, and during convalescence. In the last named period suppuration of the lachrymal sac has been noted.

Pneumonia.—The ocular complications of pneumonia may include various types of conjunctivitis, in the secretion of which the pneumococcus is found; infected ulcer of the cornea, and the so-called hypopyon keratitis, in which the same microörganism is demonstrable (Mande). A special corneal complication should be mentioned, namely, herpes corneæ, in which branching superficial and sometimes deep corneal ulcers arise, which may complicate not only pneumonia, but any of the diseases of the respiratory tract. These herpes lesions and various forms of dendritic keratitis may remain superficial, or become infected and give rise to sloughing corneal ulcers.

Optic neuritis, followed by optic nerve atrophy, may occur, as well as fundus lesions, which somewhat resemble tubercle of the choroid, and which are composed of small emboli of micrococci (Fränkel). The most serious ocular complication of pneumonia is metastatic ophthalmi-

[1] Consult Brit. Med. Jour., May 29, 1897.

[2] Consult Larionow, Klin. Monatsbl. f. Augenheilk., 1878, xvi, 487–497; also Groenouw, Graefe-Saemisch, Handbuch der Gesamten Aungenheilkunde, 1903, 67, p. 581. Groenouw's admirable article has been freely utilized in the preparation of the first portion of this section.

tis, with rapid destruction of the ocular coats as the result of a purulent choroiditis, in its turn caused by embolism from a microbic area.

Among the ocular muscle paralyses, paresis of the ciliary muscle and palsy of the oculomotor and abducens have been described. It is probable that they are due to the action of a toxin.

Tuberculosis.—The eye may be attacked primarily or secondarily by a tuberculous process. In other words, the eye may be the port of entry for the tubercle bacillus, or it may be attacked because a tuberculous infection reaches it from the neighborhood, or arrives there by metastasis. All portions of the eye may be affected by tuberculosis, but, according to Groenouw, the regions most frequently involved are the lids, the conjunctiva, and the uveal tract.[1]

Referring to the primary character of ocular tuberculosis, the investigations of Denig[2] are interesting. He found among 72 cases of conjunctival tuberculosis 38, among 86 cases of tuberculosis of the uveal tract 40, and among 31 cases of choroidal tuberculosis 10, which were proved by careful clinical investigations to be of the primary variety. Secondary tuberculous disease of the eye most frequently occurs in acute cases, while it is rare in chronic varieties. Thus, Denig, among 220 patients with tuberculosis of various organs, found only 5 associated with ocular involvement.

Tuberculosis of the eyelids appears usually in the form of lupus, and may be an extension from surrounding facial areas.

Tuberculosis of the conjunctiva develops as a primary or as a secondary affection, and, while the primary tuberculosis of this region is comparatively rare, undoubted instances are on record. Indeed, Villard maintains that in 60 per cent. of the cases which he has analyzed no initial tuberculous lesion was found, and hence he doubts its endogenous origin. The disease may appear, according to Eyre, who adopts Sattler's classification, as miliary tubercles which caseate, as grayish, subconjunctival nodules, as florid, hypertrophied papillæ, as cock's-comb excrescences, and as distinctly pediculated tumors. In rare instances tuberculosis of the tear passages has been found, either as a primary condition or as an extension from a tuberculous process in the nasal passages, and tuberculous disease of the lachrymal gland, appearing in the form of a growth in this situation, has been reported.

Primary tuberculosis of the cornea in the form of ulcers (Greeff), or as nodes in the periphery of the cornea (Bach), have been described. Usually tuberculous corneal lesions arise by reason of an extension of the disease from the uveal tract, including the pectinate ligament.

Investigations, particularly by Von Hippel and others, indicate that a fair percentage of cases of parenchymatous keratitis must be ascribed to a tuberculous diathesis, and the evidence is increasing that phlyctenular keratitis is closely connected with tuberculosis and probably caused by it. A large number, about 88 per cent., according to George Derby

[1] For an excellent article on ocular tuberculosis and an analysis of the literature, see Groenouw, Graefe-Saemisch, Handbuch der Gesamten Augenh., 1904, 81, p. 671.
[2] Arch. f. Augenheilk., 1895, xxxi., p. 359.

and Stock, of the subjects of this disease react to tuberculin—a suggestive fact, although it does not prove that the disease is caused by tuberculosis. Phlyctenules may arise as the result of the Wolff-Eisner-Calmette test and from tuberculin injections.

Primary tuberculosis of the sclera, in the form of tumors, ulcers, or abscesses, have been described, and some types of episcleritis are undoubtedly of tuberculous origin.

Tuberculosis of the iris and of the ciliary body presents itself in three forms; namely, as a tuberculous granulation tumor in the iris, as disseminated miliary tuberculosis of the iris, and as iritis or iridocyclitis. In tubercle of the iris, which usually occurs between the ages of five and twenty-five, small grayish-red nodules develop at the margin of the pupil or at its ciliary border, and may or may not be associated with synechiæ and inflammatory signs, such as one sees in ordinary iritis. Tuberculous iridocyclitis may appear as an acute inflammatory affection, especially in infants, and as a subacute disease with tumor formation in the ciliary zone. Chronic uveitis is frequently caused by tuberculosis.

Tuberculosis of the choroid may manifest itself in the form of a disseminated choroiditis, in the form of miliary tubercles in the choroid, which appear as yellowish-white spots often encircled by an ill-defined rose-colored area, and finally, in the form of a large tumor, the so-called conglomerate tubercle of the choroid, which resembles a sarcoma and produces the same destructive changes.

Tuberculosis of the retina is exceedingly uncommon, and is usually associated with a similar disease in the uveal tract.

Tuberculous growths at the head of the optic nerve have been described. The bones and periosteum of the orbit may be attacked by a tuberculous process, which produces the ordinary signs of orbital growth and inflammation.

Diphtheria.—The most important ocular complications of diphtheria are diphtheritic conjunctivitis, optic neuritis, and paralyses of the exterior and interior ocular muscles. Of diphtheritic conjunctivitis there are two chief varieties—a deep-seated necrotic form of the disease and a superficial manifestation. The former is characterized by much swelling of the lids and an exudation within the layers of the tarsal conjunctiva, which may spread to its ocular expansion. It is commonest between the ages of two and eight, and is unusual in young infants. The false membrane is of a dull, grayish appearance and is torn off with difficulty. Sloughing of the cornea is exceedingly common. The disease is seen during epidemics of diphtheria, and may be part of a process which passes from the nose to the conjunctiva, or may be due to direct inoculation with diphtheritic poison. Bacteriologic investigation of the exudation and the discovery of the Klebs-Löffler bacillus lead to a diagnosis.

Paralysis of accommodation, or cycloplegia, without mydriasis is the most common affection of the interior ocular muscles that occurs as a sequel of this disease. Usually bilateral, the cycloplegia is rarely

complete; if it is complete, it may be associated with mydriasis. Less commonly, the exterior ocular muscles are involved; paralysis of those muscles which are supplied by the oculomotor may arise, the superior oblique is occasionally affected, and most frequently one or both external recti. Several cases of paralysis of all of the ocular muscles are on record. Associated with the exterior muscle palsy there may be paralysis of accommodation. These conditions have been ascribed to a peripheral neuritis, to a hemorrhage at the nucleus of the muscles, and to a direct action of the toxin upon the muscles or the nerves.

Scarlet Fever.—A sharp conjunctivitis, as it occurs in other forms of the exanthemata, is not frequent, although during the eruptive stage there may be hyperemia and mild conjunctivitis. A rare and somewhat fatal form of conjunctivitis occasionally occurs in this disease owing to an infection with streptococci, and is associated with the formation of false membrane, forming the so-called *streptococcus diphtheria of the conjunctiva*. Phlyctenular keratoconjunctivitis as a sequel of scarlet fever is often seen, and the cornea may be involved, corneal ulcers form, and in severe cases a positive keratomalacia may arise. Much less commonly than in other exanthemata, dacryocystitis is described. Rare ocular complications are optic neuritis and orbital abscess. Retinitis, especially when associated with nephritis, has been noted in a number of instances, and uremic amaurosis with complete blindness, temporary in character, occurs in a certain proportion of cases of scarlatinal nephritis. Accommodation palsy, like that seen after diphtheria, has also been reported. Orbital cellulitis and abscess may arise as the result of infection from the accessory nasal sinuses.

Measles.—The conjunctival complications of measles are well known, and a conjunctivitis in the prodromal stage exceedingly common, increasing in severity until the second or third day after the eruption. Schottelius [1] has bacteriologically investigated the conjunctivitis occurring during the course of measles, and in a large percentage of the cases has found staphylococci and streptococci, the latter being especially common in fatal cases. I have seen streptococcus conjunctivitis in this disease followed by multiple streptococcus abscesses throughout the subcutaneous tissues of the body, death occurring from pneumonia. Phlyctenular keratoconjunctivitis is a common result of measles, not only during the height of the disease, but during convalescence and after apparent complete recovery. Either from this cause, or from infection from the surrounding conjunctiva, ulcers of the cornea may form, severe and sloughing in character, and sometimes a complete keratomalacia results. Occasionally, in place of the keratoconjunctivitis, a true superficial punctate keratitis arises. On account of the nasal conditions there may be infection of the lachrymal passages and abscess of the lachrymal sac.

Rarer ocular conditions are the following: choroiditis followed by rapid and malignant myopia; metastatic ophthalmitis and purulent infection of the choroid; optic neuritis, due probably to intercurrent

[1] Klin. Monatsbl. f. Augenheilk., June, 1904.

meningitis, which may also cause palsy of the exterior ocular muscles; and, finally, abscess of the orbit as the result of an ethmoiditis. It is possible that the ocular muscle palsies may also be due to a peripheral toxic neuritis.

Rötheln.—There are no ocular complications of importance. A mild conjunctivitis may be associated with the eruptive stage of the disease and hyperemia of the conjunctiva in the prodromal period.

Pertussis.—Not uncommonly, as the result of the violent paroxysms of coughing, there are extensive subconjunctival hemorrhages, hemorrhages into the tissue of the lid, and even hemorrhage into the orbit. Conjunctivitis of the ordinary type has also been reported, but has no special significance.

A matter of great interest is the disturbances of vision. There may be double-sided blindness, perhaps due to hemorrhage in the brain, or homonymous hemianopsia from similar cause. A curious form of blindness, the so-called mind-blindness, has been reported a few times.[1] Occasionally optic neuritis has been seen, which has gone on to recovery, but in some instances it has resulted in optic nerve atrophy. Amaurosis or blindness may occur unassociated with any ophthalmoscopic changes, the pupils being widely dilated and failing to react to light. This has been attributed either to a basal meningitis or to an edema of the brain, perhaps in the neighborhood of the corpora quadrigemina. A few instances of ocular muscle palsy have been recorded, doubtless depending upon hemorrhage in the nucleus of the nerves. It is not uncommon for patients to report the appearance of convergent strabismus after attacks of whooping-cough.

Mumps.—Mumps may be accompanied by a conjunctivitis of unimportant character, and, which is a matter of far greater interest, by inflammation of the lachrymal gland, which makes itself manifest by a tender swelling in the upper and outer portion of the orbit, and which may appear as a unilateral or a bilateral condition. The affection does not tend to produce suppuration and recovery results. In a certain number of instances mumps has been associated with inflammatory affections of the optic nerve and retina; that is to say, an optic neuritis, which has either subsided or which has gone on to optic nerve atrophy. At least one case of metastatic iridocyclitis has been recorded as the result of mumps, and in a number of instances there have been muscle palsies, affecting either the external recti or the ciliary muscle, and, therefore, causing paralysis of accommodation.

Variola.—The eye affections caused by small-pox are of frequent occurrence. They may occur in the prodromal stage, in the stage of eruption, and in the stage of desquamation, and their sequelæ may leave the eye and its appendages badly scarred and disfigured. On the lid pustules may appear, and, as secondary affections, there may be extensive abscess-formation, and even gangrene. These lid affections may result in entropion, ectropion, trichiasis, and madarosis. The conjunctiva may be intensely hyperemic or exhibit a sharp catarrhal

[1] Fritsche Troitsky, quoted by Groenouw.

conjunctivitis. Not infrequently false membrane forms, and pocks or pustules may develop on the conjunctival surface.

True pustules upon the cornea probably do not occur, but there may arise infiltrations in the cornea, parenchymatous keratitis, diffuse corneal haze, and, finally, the most violent types of infected corneal ulcers, resulting in extensive necrosis of the corneal tissue and loss of the eye, or in the formation of adherent leukomas and protruding staphylomas.

In so far as the iris and the uveal tract are concerned, an interesting condition is the so-called ciliary irritation. Primary iritis has been noted, and there may be hemorrhage in the uveal tract and the development of choroiditis, which in its turn may cause an opacity of the lens. Retinitis is not uncommon, and there may be a neuroretinitis which results in atrophy of the disk. Purulent inflammation of the lachrymal passages is frequently caused by small-pox.

Vaccinia.—Vaccine vesicles—that is, the so-called vaccine blepharitis—may form on the lid margins from accidental inoculation; for example, with the finger nail previously in contact with a vaccine pox or vaccine virus. These vesicles may develop into severe ulcers, and the bulbar conjunctiva may be involved and by secondary contraction the lid become adherent to the eyeball. An important observation is one by Schirmer, who has seen deep, circumscribed, parenchymatous keratitis due to infection with vaccine virus. This suggests to him that the variolar abscess of the cornea, to which reference has just been made, and which has sometimes been considered as an endogenous infection, really arises by penetration of the virus from without.

Varicella.—In this disease the pox may develop upon the lid, and in a few instances gangrene has arisen. Uveitis and purulent iritis have been reported, and in rare cases varicella of the cornea (Oppenheimer).

Rheumatic Fever.—In acute rheumatism, or rheumatic fever, there may occur ocular affections, no matter whether the disease is a severe one, complicated with heart lesions, or whether the affection is mild in its character. Perhaps the most important of these are the uveal tract diseases, particularly various inflammations of the iris and ciliary body. Now, while rheumatism is undoubtedly a predisposing cause of many cases of iritis, and particularly of relapsing and recurrent forms of this disease, it is a fact that acute iritis during the course of an acute joint rheumatism is exceedingly uncommon. So-called rheumatic iritis must not be confused with those iritic complications which follow or accompany acute joint rheumatism, and which depend upon metastasis of streptococci and staphylococci from purulent processes in the joints.

Episcleritis of rheumatic origin occasionally occurs, and certain types of deep or interstitial keratitis are attributed to this infection.

In rare instances, optic neuritis is a complication of joint rheumatism, and certainly it is one of the well-known causes of acute retrobulbar neuritis. Paralyses of the exterior ocular muscles, notably of the external rectus, are not infrequently rheumatic in origin, and a complete oculomotor palsy in association with a joint rheumatism has been reported.

Influenza.—The involvement of the eye in influenza is exceedingly common. Groenouw gives the following table: Among 186 cases, there were affections of the eyelids in 8, of the conjunctiva in 55, of the cornea in 58, of the uveal tract in 15, of the retina in 6, of the optic nerve in 9, of the vitreous in 3, of the lens in 4, and of the eye muscles in 16.

Among the eyelid affections the commonest are various types of edema, blepharitis, and particularly lid abscess, either in the form of acute styes or a more extensive suppurative process. The conjunctiva is frequently affected, and there is one well-known form of conjunctivitis originated by the influenza bacillus. Some varieties of influenza conjunctivitis are especially seen in children, and occasionally, as Arnold Knapp has shown, may be associated with membrane formation. The lachrymal passages may be infected from the nose, and purulent conditions of the lachrymal sac may arise. These ocular complications may be present during an attack of influenza or not appear until the period of convalescence.

Various types of corneal disease have been noted, especially herpes of the cornea, and dendritic ulcers, superficial punctate keratitis, deep or parenchymatous keratitis, and phlyctenular keratoconjunctivitis. Corneal abrasions may become infected and deep or sloughing ulcers arise.

The uveal tract is not uncommonly involved, and one of the most frequent causes of moderate grades of uveitis, with punctate deposits on the cornea and vitreous opacities, is the disease under consideration. Sometimes the inflammation assumes the type of an iritis or an iridocyclitis, and sometimes is especially located in the choroid in the form of choroiditis. Severe purulent infection of the choroid, the so-called metastatic choroiditis, may be due to influenza. Opacities in the vitreous may be secondary to choroidal disease or due to hemorrhages, and sometimes appear when it is difficult to find any lesion except the opacity of the vitreous itself.

Involvement of the optic nerve is frequent, not only in the form of optic neuritis, but especially in the form of retrobulbar neuritis, and may eventuate in optic nerve atrophy. In Uhthoff's well-known table of 253 cases of infectious optic neuritis, 72 are ascribed to influenza.

All of the forms of exterior and interior ocular muscle palsy may be caused by this infection, a common paralysis being that of the abducens, which is more often unilateral than bilateral. Paralysis of accommodation is of frequent occurrence. In so far as the orbit is concerned, tenonitis and orbital abscess are noteworthy complications, the latter being usually caused by an extension of infection from the nasal accessory sinuses, notably the ethmoid cells.

Erysipelas.—If this disease attacks the lids, abscess formation may occur, and even gangrene, and as sequelæ ectropion, entropion, and solid edema. The conjunctiva and cornea are often involved, and in severe cases of facial erysipelas hypopyon keratitis and various types of infected corneal ulcers are not uncommon, which may or may not be associated with purulent disease of the lachrymal passages. The uveal

tract may be involved, and choroiditis and iritis arise and blindness occur from extensive perivasculitis and thrombosis of the retinal vessels. Ocular muscle palsies are comparatively rare.

A very important, and perhaps the most important, of the ocular complications of this disease is orbital cellulitis, which presents a serious prognosis, fully 20 per cent. of deaths occurring in unilateral and 40 per cent. in bilateral cases. Death may be due to thrombosis of the brain, to meningitis, pyemia, pulmonary embolus, or pneumonia (Groenouw).

Septicemia and Pyemia.—These conditions may be complicated by various types of conjunctivitis, gangrene of the lids, and abscess of the orbit, but the most important ocular complications are septic retinitis and metastatic ophthalmitis.

Septic retinitis, discoverable only with the ophthalmoscope, is characterized by circumscribed white spots in the retina, and is a tolerably frequent complication of severe septicemia. A much more serious complication is purulent metastatic ophthalmitis, which is most frequently seen in puerperal pyemia, but may result from surgical pyemia and cryptogenetic septicopyemia, as well as from the various infectious diseases to which reference has already been made. In puerperal cases the mortality is extremely high, and when both eyes are involved, almost always death ensues. The ophthalmitis usually develops during the first two weeks of the disease, but may be delayed until the seventh week.[1] In surgical pyemia the disease may appear as early as the first day and as late as the forty-fifth, and when the lesions are bilateral the prognosis is exceedingly grave, the mortality being fully 75 per cent. Metastatic ophthalmitis depends upon the entrance of the septic masses into the capillaries of the eye, and bacteriologic investigation will usually show the presence of streptococci and staphylococci. Some forms of ophthalmitis are due to the Fränkel-Weichselbaum pneumococcus. Practically always the eye is destroyed.

Syphilis.—In order to show the frequency with which syphilis attacks the various tissues of the eye the following statistics, gathered by Groenouw,[2] may be quoted: Among 3622 cases of syphilitic ocular affections the lids and conjunctiva were attacked 40 times, the cornea 150 times, the sclera 7 times, the uveal tract 1566 times, the retina 229 times, the optic nerve 887 times, the tear passages 49 times, the orbit 8 times, the ocular muscles 563 times, the remaining 123 cases not being specially classified. Syphilitic eye affections are usually bilateral, certainly in considerably more than half the cases.

Syphilis of the eyelids may exist either as a primary sore or as a secondary or hereditary manifestation. According to De Beck, a chancre usually appears on the area included by the lid borders and inner canthus, the tarsal conjunctiva and the cul-de-sacs. The lesions of secondary syphilis may appear upon the eyelids; gumma occasionally occurs in this region, which breaks down into ulcers, forming the so-

[1] Consult Concerning Metastatic Ophthalmitis, by G. E. de Schweinitz, University of Pennsylvania Medical Bulletin, May, 1905.

[2] Loc. cit., p. 739.

called tertiary ulcers. A papular eruption may develop on the eyelids of children who are the subjects of hereditary syphilis. The conjunctiva may be the seat of a primary sore, may be attacked by a form of conjunctivitis which, on account of its appearance, is known as syphilitic granular conjunctivitis, and may be the seat of various types of syphilitic papules. Gummas have also occurred in this region. If the lachrymal passages are attacked by a syphilitic process it is usually an extension from neighboring tissues, although primary affections of this region have been recorded and syphilis of the tear gland is known, although uncommon.

Acquired syphilis may cause an interstitial keratitis closely resembling that variety which depends upon the hereditary form of the affection. It is apt to be unilateral, and may follow a chancre of the lid. A rare syphilitic disease of the cornea is true punctate syphilitic keratitis. Some types of episcleritis and scleritis are undoubtedly syphilitic in origin, and in this sense the sclera may be involved.

According to Alexander, in from 30 to 60 per cent. of the cases of iritis syphilis is the etiologic factor. This iritis may appear between the second and ninth month after the initial lesion or may be delayed until the eighteenth month. Occasionally, it arises only in the late or so-called tertiary period. The lesions are due to the influence of the syphilitic virus; that is, to the lodgment and activities of the spirochete pallida. These lesions may be those of an ordinary iritis, unaccompanied by the characteristic signs which would justify the diagnosis of syphilis, although localized sphincter lesions always suggest the influence of this infection. A somewhat characteristic type of syphilitic iritis occurs with the development of yellowish-red nodules, situated at the pupillary or ciliary border of the iris, and, in contrast to ordinary plastic iritis, is sometimes called true syphilitic iritis, or syphilitic parenchymatous iritis. Even in the absence of distinct nodules careful examination of the iris will usually show fine discolored swellings in the edematous tissue.

Gumma of the iris almost constantly appears at the ciliary border and is a late manifestation, arising in the so-called tertiary period of syphilis, when gummas are found in other organs of the body. The iris is rarely alone attacked by the syphilitic virus, the ciliary body being involved usually in the inflammation.

Occasionally iritis appears in that form which is especially associated with the formation of dots on the posterior surface of the cornea, which at one time was called serous iritis, but which is a uveitis, and which may be an early syphilitic lesion, or sometimes occurs late, years after the primary affection. Gummas may be limited to the ciliary body and cause a destructive inflammation of the eye. Various types of choroiditis are caused by syphilis, particularly disseminated choroiditis, often associated with haziness and punctate deposits in the vitreous, and appearing from six months to two years after the initial infection. Sometimes, however, choroiditis is postponed to the tertiary period.

Syphilitic retinitis may appear in the form of a choroidoretinitis, a

retinitis with exudations, a retinitis with hemorrhages, and a retinitis which particularly attacks the central area and is relapsing in character. So, too, the retinal vessels may be involved in a true syphilitic endarteritis. In acquired syphilitic retinitis the disease usually appears from one to two years after infection, but is sometimes seen as early as the eighth month. Primary syphilitic optic neuritis is uncommon; but papillitis as a manifestation of cerebral syphilis is frequent. Such neuritis may terminate in optic nerve atrophy; occasionally in primary atrophy of the optic nerve due to syphilis. Various forms of primary or gray atrophy of the optic nerve, especially as they are associated with locomotor ataxia, are among the commonest of the syphilitic manifestations. Instead of an intraocular optic neuritis, retrobulbar neuritis of syphilitic origin may develop.

Syphilis is the most frequent cause of exterior ocular muscle palsies and is the etiologic factor in fully one-half of the cases. The resulting paralysis may be due to an inflammation or gummatous change, affecting the nerves at the base of the brain or in the orbit, or may be central in origin and result from disease of the nuclei of the nerves, or of the brain in their immediate vicinity, or from lesions of the third ventricle, the aqueduct of Sylvius, or the fourth ventricle. While syphilitic paralyses are generally late manifestations, as the result of intracranial and other lesions, they may occur quite early and are toxic in origin. This is particularly true of ptosis, which has been noted within the first six weeks or two months after syphilitic infection. The intraocular muscles are frequently affected by syphilis and interpret their disabilities by cycloplegia, with or without mydriasis. Such a condition may be part of a general oculomotor palsy. Of the orbital syphilitic lesions the most important are various forms of gumma in the orbital tissue and gummatous periostitis, followed by caries and necrosis of the orbital walls.

Inherited syphilis is responsible for a number of important ocular lesions, of which the most noteworthy are interstitial or parenchymatous keratitis, which usually appears between the ages of five and fifteen, some forms of iritis seen in children from the second to the fifteenth month, and various types of choroiditis and choroidoretinitis.[1]

Gonococcic Infection.—Among the gonococcic ocular complications, five are of extreme importance; namely, conjunctivitis neonatorum, ordinarily known as ophthalmia neonatorum, gonoblennorrhea of young girls, gonorrheal conjunctivitis of adults, metastatic gonorrheal conjunctivitis, and gonorrheal iritis.

Ophthalmia neonatorum and gonorrheal conjunctivitis of adults represent in their severe forms most violent ocular inflammations, manifesting themselves by free purulent secretion from the conjunctiva and much swelling of the lids and bulbar conjunctiva. In the secretion the gonococci of Neisser are freely present. Untreated, or improperly managed, they are sure to terminate, if not in blindness at least in

[1] For alterations in the eyeground in congenital syphilis, see Haab's Ophthalmoscopy, edited by G. E. de Schweinitz, Figs. 39 and 40.

severe ulceration or sloughing of the cornea, followed by dense corneal scars and staphyloma, and often in destruction of the ocular globe. Gonoblennorrhea of young girls usually arises from an infection carried from a purulent vaginitis (in the secretion of which gonococci are found) to the conjunctiva. In asylums it occasionally appears as an epidemic among the inmates.

Gonorrheal iritis, usually plastic in character, generally does not coincide with nor immediately follow the gonorrheal attack. An arthritis of the knee or of the ankle sometimes intervenes. Occasionally the disease occurs with gonorrhea. The affection is due to the action of the gonococci or their toxins on the iris.

Metastatic gonorrheal conjunctivitis is comparatively mild in character, nearly always bilateral, and occurs in patients who at the same time have articular affections, or may be the only expression of systemic gonorrhea. Sometimes it is followed by rheumatism, and it may be associated with small ulcers of the cornea. It is caused by the gonococcus carried through the circulation to the conjunctiva or by the gonotoxin.

Tetanus.—The ocular muscles may be involved in the general tetanic contraction, and various types of ocular muscle palsy have been reported, as have also mydriasis and paralysis of accommodation; but the chief ocular interest of the disease is the fact that injuries in the eye may be the port of entry of the tetanus bacillus, and be followed, therefore, by general tetanic convulsions.

Anthrax.—The chief ocular lesions of anthrax consist in those which attack the lids in the form of the so-called malignant pustule, or specific anthrax, caused by the entrance of the bacillus anthracis, and of malignant edema of the lids, or a form of spreading gangrene. They have usually been found among persons whose occupation brings them in contact with diseased animals or decayed animal matter. In rare instances anthrax carbuncle involves the mucous membrane, and, therefore, the conjunctiva, but anthrax infection of the cornea, so far as I am aware, has not been found in human beings.

Glanders.—According to Groenouw, primary glanders of the eyelid is an uncommon affection, the few cases reported consisting of ulcers and pustules in this region. Sometimes the conjunctiva is involved. Abscess of the orbit from this cause has been reported, as has also an involvement of the tear passages.

Actinomycosis.—Primary actinomycosis of the eye is particularly interesting in connection with the cases which have been reported of obstruction of the lachrymal canal with the fungous masses. Infection of the conjunctiva has also been described, and a retrobulbar abscess with ptosis and exophthalmos and fistula has been reported.

Foot-and-mouth Disease.—This disease is occasionally accompanied by a severe conjunctivitis, which, however, has nothing characteristic in its clinical features.

Epidemic Cerebrospinal Meningitis.—In this affection, due to the *meningococcus intracellularis* of Weichselbaum, ocular complications

are not uncommon. Conjunctivitis has been noted in varying frequency by different investigators, due either to defective closure of the lids or else of endogenous origin. The specific microörganism has been found in some of the affected conjunctival sacs. The corneal complications have consisted in dendritic keratitis due to accompanying herpes; severe secondary ulcerative keratitis, and in deep corneal infiltrates, an uncommon manifestation, observed by Uhthoff and by myself and Hosmer. Iritis, iridocyclitis, and iridochoroiditis have been observed, but less commonly than in relapsing fever, while metastatic ophthalmitis (endophthalmitis), sometimes unilateral and less frequently bilateral, has been noted in from 4 to 5 per cent. of the cases (Uhthoff). This affection begins either as a metastatic retinitis or choroiditis, and depends upon transmission of the meningococci by the blood-streams. The microörganisms have rarely been found in the affected eye; they probably degenerate and disappear (Parsons).

The optic nerve and retinal involvements are: optic neuritis in slight degree, which is common; typical choked disc, which is rare; and optic nerve atrophy, which follows an inflammation of the opticus, or may result from the direct pressure of exudations on the chiasm. Preretinal hemorrhage, retinal hemorrhages, and thrombosis of the central vein of the retina (Randolph) have been reported.

The exterior ocular muscles are frequently (14 to 15 per cent. of the cases, according to Uhthoff) involved in the disease under consideration, and there may be abducens palsy, partial or complete oculomotor palsy, palsy of the superior oblique (rare), and even total exterior ophthalmoplegia. Inequality of the pupils, early dilatation of the pupils, myosis (frequent), and reflex immobility of the pupils have been noted. An extremely rare complication is orbital cellulitis.

In the sporadic varieties of the disease (posterior basic meningitis) optic neuritis, pallor of the discs, and amaurosis have been noted.[1]

Asiatic Cholera.—In Asiatic cholera the following conditions have been noted: Marked cyanosis of the lids, remarkable diminution in the flow of tears, injection of the conjunctiva, and occasionally abscess and necrosis of the cornea, especially in severe algid forms. Hemorrhage into the choroid and iritis, as well as opacities of the crystalline lens and the vitreous, have been reported. There are marked contraction of the retinal arteries, and imperfection in this respect of the retinal circulation. The retinal veins, on the other hand, may be exceedingly dark in color. A very rare condition is atrophy of the optic nerve following an attack of cholera.

Plague.—The ophthalmic complications of plague have been investigated by several writers (Calmette, Maynard), and the following lesions have been reported: Corneal ulcers, parenchymatous keratitis, iritis and iridocyclitis, panophthalmitis, opacity of the lens, and retinal hemorrhage.

[1] For a full account of the ocular complications of cerebrospinal meningitis the reader is referred to Uhthoff, Graefe-Saemisch Handbuch der Gesamten Augenheilk., zweite auflage, 1907, Bd. xi, 770, where the literature is analyzed.

Yellow Fever.—It is stated that during the prodromal period of yellow fever the eyes have a somewhat characteristic appearance. They are flushed, weep readily, and have a curious staring look. Severe complications are occasionally reported—keratitis, hemorrhage in the conjunctiva, the lid-skin, and the vitreous, as well as the anterior chamber. Other conditions being equal, uremic amaurosis may be present. Optic neuritis followed by optic nerve atrophy has been reported (W. K. Rogers).

Dengue Fever.—The ocular complications of dengue fever are apparently infrequent, but Van Millingen has recorded metastatic ophthalmia.

Leprosy.—Leprosy may attack the various portions of the eye and the ocular adnexa, and the lesions of this disease have been found in the eyebrows, the lids, the conjunctiva, the sclera, the cornea, the iris, the ciliary body, and the choroid. They have been particularly well studied by Borthen. Leprosy attacks the eyelids very frequently. According to Lopez, two-thirds of those affected with this disease suffer from lesions in this region.

Dysentery.—The ocular complications following this disease are uncommon. Edward Jackson has reported optic nerve atrophy. Paralysis of accommodation has been noted, and in some instances hemorrhage into the uveal tract, particularly into the choroid.

Weil's Disease.—Infectious icterus is occasionally associated with severe ocular complications; for example, hemorrhage into the conjunctiva and the retina, iridocyclitis associated with hypopyon, and, as a late complication, paralyses of the ocular muscles.

Malaria.—The ocular complications of malaria are numerous.[1] The following have been reported: An ophthalmia of the intermittent type, that is to say, a form of relapsing conjunctivitis which sometimes replaces the ordinary manifestations of the disease; a form of keratitis, particularly of the dendritic variety, properly described as malarial keratitis, and quite distinct from those types of corneal inflammation which are simply associated with intermittent fever; various functional ocular disturbances, amblyopia, paresis of accommodation, changes in the field of vision, even hemianopsia, and night blindness; and, finally, gross changes in the interior of the eye, optic neuritis, optic nerve atrophy, retinal hemorrhages, and hemorrhage into the vitreous.

Relapsing Fever.—That severe ocular complications may be associated with relapsing fever has been known since the early times, and they have been investigated by Wallace, Mackenzie, and other writers of that period. Especially noteworthy is the development of cyclitis, sometimes with hypopyon, which may appear either in an acute or in a chronic form, and, according to Groenouw, the frequency of uveal tract disease in this affection may vary from 2 to 12 per cent. He further states that the beginning of the ocular affections appears but rarely during the fever or between the attacks. As a rule, it

[1] See the Ocular Complications of Malaria, by G. E. de Schweinitz, The Medical News, June 7, 1890.

appears after the last onset, and it may be some months after its appearance.

Beriberi.—In this disease amblyopia and amaurosis, as well as optic neuritis and atrophy of the optic nerve, have been found. In some of these cases of amblyopia there is a typical central scotoma for colors. Not infrequently there are ocular muscle palsies, and there may be paralysis of accommodation. These depend, undoubtedly, upon the development of a neuritis.

Trypanosomiasis.—The ocular lesions of trypanosomiasis in the lower animals have been thoroughly studied, and include blepharo-conjunctivitis, parenchymatous and ulcerative keratitis, and degenerative changes in the optic nerve. In so far as human beings are concerned, iritis, iridocyclitis, choroidal atrophy, and temporary impairment of vision have been described, and the whole subject has been especially investigated by Morax in Paris. Iritis occurred, followed by cyclitis, in one of his patients, some months after infection by the trypanosoma gambiensis, in spite of atoxyl treatment.

TREATMENT OF DISEASES OF THE LID

Blepharitis.—This term includes the various grades of subacute and chronic inflammation of the border of the eyelid, and which are most apt to be seen, in so far as the infectious diseases are concerned, in association with, or as the result of, the various exanthemata, and particularly measles. If the patient has sufficiently recovered, the refractive error should first be corrected, as the various anomalies of refraction not only provoke, but foster the condition. Should the disease present itself simply in the form of a hyperemia of the lid border, so-called vasomotor blepharitis, ordinary douching of the lids, or washing them with tepid water or boric acid solution, is usually sufficient. If the crusts form on the lid margin, and the scales represent a form of seborrhea, they should be removed by means of alkaline solutions, preferably bicarbonate or biborate of sodium, gr. viij to the ℥j, or with a 5 per cent. solution of chloral. The margin of the lid may then be anointed with the yellow oxid of mercury, gr. j to f℥j, or a 2 per cent. solution of milk of sulphur. If the crusts are more persistent, and represent a type of eczema, they should all be removed with the same solutions, or with epilating forceps, and all the loose cilia at the same time should be extracted. Afterward the yellow oxid ointment may be employed, or ichthyol in 2 to 10 per cent. solution, or boric acid ointment 10 per cent., or aristol ointment (aristol 15 gr., vaselin and lanolin, each 75 gr.). Expression of the lid margin in order to remove pathologic material is of service. Should there be much secretion, especially of a mucopurulent character, the edges of the lids may be painted with nitrate of silver, 5 gr. to the ounce, or argyrol, 25 per cent., or protargol, 5 to 20 per cent., may be similarly applied. Painting the inflamed lid margins with ½ per cent. solution of zinc sulphate is of advantage if bacteriologic examinations should reveal the Morax-Axenfeld bacillus

(McNab). Great care must be taken that the lachrymal passages are patulous, and, if they are not in this condition, the puncta should be dilated and the lachrymal duct irrigated with a saturated boric acid lotion. Associated nasal catarrh should receive appropriate treatment.

Vaccine blepharitis and *accidental vaccination of the eyelids* indicate only mild measures for their relief; that is to say, frequent irrigations with 4 per cent. boric acid lotions or physiologic salt solution. Thillies recommends a 1 per cent. solution of methyl-blue and also collargol. I have never observed good effects from methyl-blue in these conditions, and believe, with Baker, that the mild lotions are more efficacious than active antiseptics and astringents. If the cornea should be involved, the treatment of keratitis elsewhere described is appropriate.

Styes, Abscess of the Lid, and Furuncle of the Lid.—These may appear in association with various types of exanthemata, and are especially noteworthy in connection with influenza. If an abscess threatens, pointing should be favored by hot carbolized fomentations, or compresses soaked in hot saturated boric acid lotion, and when fluctuation is detected the abscess should be opened with a sharp knife. The same directions apply to the treatment of furuncle of the lid. Styes may sometimes be aborted by the vigorous application of a hot boric acid lotion, or by an inunction with an ointment of the red or yellow oxid of mercury (gr. j–f℥j), but usually are best treated by encouraging suppuration with hot-water compresses, to which may be added the extract of hamamelis, and at the earliest appearance of pus an incision should be made through the base of the swelling parallel to the edge of the lid. In persistent and recurring formation of styes, treatment with bacterial vaccines, controlled by determining the opsonic index, is worth consideration. These styes are almost always due to staphylococcus infection. As soon as possible the refractive error should be corrected and suitable glasses ordered.

Erysipelas of the lid requires no treatment other than that which is indicated by the erysipelas of the face from which it usually has spread. I have been impressed with the value of ichthyol ointment applied to the affected areas, associated with the internal administration of the tincture of the chlorid of iron. Complications, such as sloughing of the lid, ectropion, entropion, and trichiasis, must be treated by surgical measures after the subsidence of the erysipelatous inflammation. The resulting edema, sometimes in the form of a solid edema, is most intractable; massage of the lids may be tried.

Anthrax of the lids and *malignant edema*, or *spreading gangrene of the lids*, should be treated by suitable incisions and by hot compresses steeped in boric acid solution to promote separation of the sloughs, and various antiseptic lotions, notably bichlorid of mercury, 1 : 8000, cyanid of mercury, 1 : 2000. If the ulceration continues to spread it may be necessary to check it with the actual cautery.

TREATMENT OF DISEASES OF THE CONJUNCTIVA

Simple conjunctivitis, ordinarily known as *catarrhal conjunctivitis*, is seen frequently with facial erysipelas, pulmonary disorders, typhoid fever, rheumatism, and especially with the various exanthemata, notably measles and small-pox, being then known as exanthematous conjunctivitis. The type of the disease may be mild, and is associated only with the typical injection of the conjunctiva and the presence of a moderate mucopurulent discharge, in which staphylococci and sometimes streptococci and pneumococci are present. If not otherwise contra-indicated, cold compresses are agreeable and suitable. Sometimes, however, they must be replaced with hot-water bathings. The conjunctival cul-de-sac should be frequently irrigated with a collyrium of boric acid, 10 to 15 gr. to the ounce, or with a lotion of boric acid, 10 gr., sodium chlorid 2 gr., and distilled water 1 oz., or with biborate of sodium, 8 gr. to the oz. The addition to these solutions of rose water, camphor water, cherry-laurel water, etc., is not only not necessary, but usually disadvantageous. If the discharge is free, it may be checked by everting the lid and painting its inflamed surface with a solution of nitrate of silver, 5 gr. to the oz., and neutralizing the excess with a physiologic salt solution. The newer salts of silver are used for the same purpose, and of these argyrol, 10 to 25 per cent., which may be dropped directly into the conjunctival sac, is the most efficient.

Largin, 5 to 10 per cent.; protargol, 5 to 20 per cent.; argentamin, 5 per cent.; and collargol, 5 per cent., have been recommended, but are not in my experience as efficacious as the remedies previously named. Care must be taken not to use any of these silver salts for too long a period, lest they produce staining of the conjunctiva, the so-called argyrosis conjunctivæ, and it is most injudicious to allow patients to use them without supervision.

If the secretion is very free, bichlorid of mercury, 1 : 10,000, is suitable, or cyanid of mercury, 1–2 : 5000, and occasionally, especially if the Morax-Axenfeld bacilli happen to be present in the secretion, the sulphate of zinc, 2 to 4 gr. to the oz., makes an excellent lotion. Cocain should not be added to the various collyria under these conditions, as it has a deleterious effect on the corneal epithelium, and the preparations of suprarenal extract, usually employed in the form of adrenalin chlorid, except as temporary agents for blanching purposes, are not advisable. While they decrease temporarily the congestion, they do not add, in the long run, to the efficiency of the treatment.

Acute contagious conjunctivitis, the *pink eye* of common parlance, in the secretion of which Koch-Weeks bacillus is found, is of frequent occurrence. Its treatment does not differ from that already described. If bacteriologic examination reveals the presence of pneumococci (pneumococcus conjunctivitis), the sulphate of zinc lotion, already named, is especially efficacious. Influenza bacillus conjunctivitis, already referred to on p. 738, characterized by the presence of the influenza bacillus, very difficult to distinguish from the Koch-Weeks bacillus, requires no treatment other than that already named.

Special Forms of Conjunctivitis.—*Forms Due to Gonococcic Infection; that is, Conjunctivitis Neonatorum (Ophthalmia Neonatorum) and Gonorrheal Conjunctivitis of Adults.*—Ophthalmia neonatorum usually appears from forty-eight to seventy-two hours after the birth of the child. Generally it is bilateral, although one eye may be more affected than the other, and the inflammation, therefore, appear earlier in that eye. It should be differentiated from mild types of conjunctivitis of the newborn by the presence of the gonococci in the secretion. Any secretion from a newborn baby's eyes should be at once submitted to a bacteriologic examination, and if gonococci are present the treatment must be prompt and active. The three chief indications are to reduce the inflammatory swelling of the lid, to free the conjunctiva from secretion, and to check the development of corneal complications or treat them if they have arisen.

If during the earlier stages the lids are tense and swollen, iced compresses, made by taking small squares of patent lint, which are chilled by being placed upon a block of ice, and transferred from it to the closed lids, and changed with sufficient frequency to keep up a uniform cold impression, may be employed. In young infants it is doubtful whether their application should be continuous, but they may be used with good effect for from ten to twenty minutes each hour during the first twenty-four to thirty-six hours of the disease, provided the nutrition of the infant is good, the cornea bright, and the result of the treatment beneficial. Much judgment, however, is required to know when to employ cold compresses and when to omit them, and in the opinion of many surgeons of large experience, notably Myles Standish of Boston, they are more apt to do harm than to do good, and he believes, therefore, that they should not be recommended. This has not been my experience, although I recognize that they are not to be used simply because a case of ophthalmia neonatorum exists, but only if the indications for them, already named, are present.

The conjunctival cul-de-sacs should be frequently cleansed by irrigating them with a saturated solution of boric acid, with a physiologic salt solution, or with a solution of bichlorid of mercury, not stronger than 1 : 8000 or 10,000, or with a solution of cyanid of mercury, 1 : 5000. Of these solutions, the saturated boric acid collyrium is the one most generally applicable and is the safest. It is a mistake to use strong antiseptics, lest they injure the corneal epithelium.

Formerly it was advised that, as soon as the lids lose their tense character and the secretion becomes creamy, the tarsal conjunctiva should be everted and carefully brushed over with a solution of nitrate of silver, 10 to 15 gr. to the oz., and the excess neutralized with a physiologic salt solution. Because, under these circumstances, nitrate of silver, when not properly neutralized, may cause injury to the corneal epithelium, and because it is a painful application, within the last few years it has been abandoned by many surgeons, and in its place either argyrol or protargol has been employed. Argyrol should be used by what is known as the "*immersion method*," as advocated by Myles

Standish and Bruns; that is to say, the conjunctival sac is kept flooded with a few drops of the solution instilled with sufficient frequency to accomplish this purpose. This solution is not irritating, and may be used in a strength of 25 per cent. As the secretion diminishes the frequency of the application may be lessened.

According to Stephenson, in gonorrheal conjunctivitis neonatorum a 25 per cent. solution of argyrol painted once or twice a day over the conjunctiva, exposed for that purpose by eversion of the lids and carefully dried from adherent discharge with the frequent instillation of a 25 per cent. or of a weaker solution, represents a method of treatment more promptly efficacious than any other with which he is acquainted. My own experience, especially in the Philadelphia General Hospital, is in accord with the good results ascribed to the methods of using argyrol just recorded only in so far as mild cases of ophthalmia neonatorum are concerned. The treatment under such circumstances achieves good results, not because the action of the drug is more efficient in controlling the disease than is nitrate of silver, but because argyrol is more readily applied, is a less irritating remedy, and in inexperienced hands a safer one. The fact remains, however, that in a number of cases argyrol treatment will not be sufficient, and nitrate of silver must be used in the manner already described, especially in addition to or after the use of argyrol. I am entirely unconvinced that argyrol should replace nitrate of silver, although I employ it as part of the treatment of ophthalmia neonatorum in suitable cases. Protargol possesses no advantages over nitrate of silver, and in my experience is not nearly as good.

If nitrate of silver is employed, its application thoroughly once in twenty-four hours is sufficient, and the conjunctival sac may be kept greased with a little liquid vaselin. It is important that the treatment should be entrusted to skilled hands, and upon the faithfulness of its carrying out depends its success. If ulceration should appear in the cornea, or if the cornea is ulcerated when the patient first comes under observation, a weak solution of atropin sulphate, 1 or 2 gr. to the oz., may be dropped into the eye two or three times a day. I have not found eserin or pilocarpin drops, at one time much recommended in peripheral ulceration of the cornea, of much value under these circumstances.

Prophylaxis.—The eyes of those children who have passed through a birth canal known to be infected, or from which the suspicion of infection cannot positively be eliminated prior to birth, should be treated according to the method of Credé, which is as follows: As soon as the head is born, the lids are carefully cleansed, parted, and two drops of a 2 per cent. solution of nitrate of silver are instilled into each conjunctival sac. Small cold compresses are next laid upon the lids and renewed at suitable intervals. Occasionally severe reaction follows—conjunctival hyperemia or catarrh (the so-called silver catarrh), and even hemorrhage from the conjunctiva and corneal haze. Therefore, this method need not be employed in all cases, and even in those in which it is indicated recent investigations have shown that a 1 per cent. solu-

tion of nitrate of silver is sufficient in strength. If infection or the suspicion of infection can be excluded, mild measures are sufficient; for example, washing the surface of the eyelids and flushing the conjunctival sacs with a saturated solution of boric acid. In place of nitrate of silver, the newer silver salts, especially argyrol and protargol, have been employed. These remedies, however, are not to be trusted in the management of eyes which have been exposed to gonorrheal infection during birth, and the value of Credé's method is so firmly established that it should never be neglected if the birth canal is known to be infected with gonorrhea or if the suspicion of infection cannot be excluded. Conjunctivitis neonatorum should be listed as a reportable disease, and laws should be enacted to this effect. The distribution by health boards of circulars of advice to midwives and mothers, and of tubes containing the chosen prophylactic, preferably a 1 per cent. solution of nitrate of silver, as F. Park Lewis, J. Clifton Edgar, and F. F. Wesbrook have pointed out, should be required.

The treatment of gonorrheal conjunctivitis of adults, which disease usually appears from twelve to forty-eight hours after inoculation, is exactly the same as that which has been described in connection with ophthalmia neonatorum, and I am convinced that in this disease cold applied to the swollen lids, in the manner already described, is efficacious, especially during the first thirty-six or forty-eight hours. To control the disease, to act as an antiseptic, as well as a superficial cauterant, there is no remedy equal in value to nitrate of silver properly applied. The lids should be carefully everted, freed from all secretion, and painted with a 2 per cent. solution of this drug until all of the everted surfaces are covered with a fine white film, which represents the chlorid of silver and the destroyed superficial epithelial cells. Next, either a physiologic salt solution or a saturated solution of boric acid should freely irrigate the exposed surfaces until all of this white film is washed away, when the lids may be returned to their proper position and a little liquid vaselin inserted between them. Some surgeons, notably Myles Standish of Boston, prefer to treat this disease with a 25 per cent. solution of argyrol by the immersion method already described, and in some investigations made in Boston it was believed that it was demonstrated that protargol served a somewhat better purpose than argyrol, in so far as gonorrheal ophthalmia of adults is concerned. Now, while it is perfectly proper to use argyrol by the immersion method in the treatment of gonorrheal ophthalmia of adults, because it acts as a protective and floats the pus which accumulates in the folds of the conjunctiva to the surface, rendering its removal easy, my experience in the Philadelphia General Hospital convinces me that it is entirely unsafe to trust to the action of this drug alone in this disease. Argyrol is practically without antiseptic properties, and to control a virulent gonorrheal ophthalmia thus far no remedy has been discovered which exceeds in value that of properly applied 2 per cent. nitrate of silver.

I am also convinced that the Kalt method is often of great service; that is to say, copious irrigations of permanganate of potassium, 1 : 5000,

a pint at a time. These irrigations should be performed three or four times a day, according to the severity of the infection and the quantity of discharge.

Many other remedies have been used in the treatment of adult and infant gonorrheal conjunctivitis; for example, aqua chlorina, cyanid of mercury, 1 : 1500, formaldehyd, 1 : 5000, argentamin 2 per cent., a 3 per cent. solution of ichthargan (Darier) and blenolenicet salve. Anti-gonococcic serum has been tried and good results reported. These remedies, however, so far as I am able to ascertain, do not possess virtues which should make them replace those which have been more fully described.

The appearance of ulceration or haze in the cornea does not contra-indicate the ordinary treatment just described, but atropin (gr. iv–f℥j) should be instilled with sufficient frequency to maintain mydriasis; indeed, it is advisable to use this drug from the very onset of the disease. Cauterization of corneal ulceration, in the manner presently to be described, in connection with sloughing ulcers of the cornea (p. 754) is often required, and incision of the rim of hard chemotic conjunctiva which surrounds the corneal margin is of signal service. If only one eye is affected, as is not infrequently the case, the other eye may be protected by means of a suitably placed shield, preferably a watch-glass crystal, fastened with strips of collodion, which prevents the secretion from reaching the unaffected eye, and at the same time permits its constant inspection.

The prognosis of ophthalmia neonatorum is better than that of the gonorrheal conjunctivitis of adults, but in both of these diseases is serious. In general terms, in conjunctivitis neonatorum, if the eye is seen while the cornea is still clear, except in diphtheritic types and those with inherent malignancy, or where depreciation of nutrition diminishes the resisting power of the child, the majority of cases should be brought to a successful termination, provided the lines of treatment already detailed are conscientiously carried out. If bacteriologic examination demonstrates the absence of gonococci, while the case is still one of conjunctivitis neonatorum, it is not serious in its nature, because these blenorrheas then assume the appearance of an ordinary catarrh and are originated by various organisms; for example, pneumococcus, streptococcus, bacterium coli, and staphylococcus, and should be treated as is an ordinary catarrhal conjunctivitis. The prognosis of the gonorrheal conjunctivitis of adults is always exceedingly grave, and the affected eye in well developed cases rarely recovers without some corneal involvement. Only too often this involvement is extensive, and the eye is hopelessly marred and sometimes entirely destroyed.

Metastatic gonorrheal conjunctivitis, as already noted, resembles a moderate catarrhal conjunctivitis, and the treatment is exactly the same as that which is suited to an ordinary conjunctival catarrh. Gonoblenorrhea of young girls should be treated as is conjunctivitis neonatorum.

Gonorrheal iritis (see p. 761) requires the same treatment, in general

terms, which is suited to other types of iritis, and which is described on p. 757. In a few instances good results in gonorrheal iritis have been achieved by treatment with gonococcus vaccines.

Diphtheritic conjunctivitis, as already pointed out on p. 734, depends upon the formation of a diphtheritic exudation within the layers of the tarsal conjunctiva, which spreads to the ocular conjunctiva, and in which the Klebs-Löffler bacilli are freely present. The eyes should be frequently cleansed with warm boric acid solution, or bichlorid of mercury, 1:8000, and atropin drops may be instilled, but the greatest reliance should be placed upon diphtheria antitoxin, which should be promptly administered, exactly as it is in ordinary faucial diphtheria. Since the introduction of this remedy, for the methods of the administration of which full instructions are given on p. 291, many eyes have been saved, and the prognosis of this affection rendered much better than it was in previous days. Just because there are other forms of membranous conjunctivitis, not diphtheritic in character but clinically closely resembling this disease, it is of paramount importance that in all cases of membrane formation on the conjunctiva bacteriologic investigation should be undertaken, and in any doubtful case, even if the bacilli are not found, antitoxin should be administered.

Syphilis of the conjunctiva, manifesting itself in the manner already described, does not require any treatment except that which is suited to the stage of the constitutional infection, and the greatest reliance must be placed upon the various preparations of mercury and upon iodid of potassium, together with suitable cleansing of the affected area with mild antiseptic solutions.

In tuberculosis of the conjunctiva (p. 760) destruction of the diseased tissue with a curet or galvanocautery, the surface afterward being dusted with iodoform powder, was at one time a regulation treatment. Indeed, Lundsgaard, whose experience has been a large one, recommends extirpation of the diseased tissue, if this is possible; if not, treatment with the Finsen rays, or destruction with the actual cautery. On the other hand, Ormond and Eyre recommend injections of *tuberculin* T. R., which they consider far superior to excision and scraping. Stephenson suggests the trial of *x*-rays.

TREATMENT OF DISEASES OF THE CORNEA

Phlyctenular keratitis, or, because the conjunctiva is so frequently involved in the process, *phlyctenular keratoconjunctivitis*, complicates or follows a number of infectious diseases, notably the exanthemata and influenza. It is characterized by the development on the conjunctiva, at the corneoscleral margin, or on the cornea itself, of single or multiple pimples, little elevations technically known as phlyctenules, which may disappear, or which may break down and form ulcers, and which are particularly frequent in children, especially if they are of the so-called strumous diathesis. As has already been pointed out, there is good reason to believe that phlyctenular keratitis represents a tuberculous infection.

As the disease is practically always accompanied by intense photophobia and lachrymation, and the child spasmodically closes its eyelids or buries its head in the pillow to escape the surrounding light, an application of the local remedies can only be made properly if the child's head is taken between the surgeon's knees, and the lids separated while the assistant holds the hands and the body. The local remedies are as follows: A warm saturated boric acid solution should be frequently employed to flush out the conjunctival cul-de-sac, and atropin drops, 4 gr. to the oz., should be instilled with sufficient frequency to maintain mydriasis. While cocain may be used to allay photophobia for an examination, its frequent application when corneal ulcers exist is to be deprecated. It does not tend to cure the disease, but rather to increase the ulceration, because it lowers the nutrition of the cornea. As soon as the photophobia subsides, the little corneal infiltrates may be encouraged to absorption by introducing between the lids a small portion of ointment, composed of the yellow oxid of mercury, 1 gr. to the dram. In its place calomel is sometimes employed, dusted directly into the conjunctival sac, but should never be used if the patient is at the same time taking iodid of potassium, or, indeed, any form of iodin, as under these circumstances a severe reaction will take place. Douching the eyes with cold water will sometimes subdue the dread of light, and the slight fissure at the angle of the lids, which keeps up the photophobia, may be treated by touching it, as Koller has suggested, with a crystal of blue stone.

Many antiseptic powders have been employed in this disease, which may be dusted into the conjunctival sac; for example, iodoform, gallacin, iodogallacin, bismuth, oxyodidtannate, aristol, nosophen, europhen, and dermatol. Of these, nosophen and iodoform have given the greatest satisfaction. If, in spite of these measures, the corneal ulceration persists, or begins to spread, more active measures, suited to infected corneal ulcers, presently to be described, are indicated, and when, as is sometimes the case, the phlyctenules drag after them a leash of injected blood-vessels, good results may follow the application of the actual cautery to this leash of vessels. Under these circumstances linear cauterization of the fornix is sometimes of service.

But the local treatment of this disease is unavailing if surrounding conditions are neglected, particularly the nasopharynx, which is apt to exhibit an infected rhinitis, and often the turbinals are swollen and vasoparetic, or the child suffers from adenoids. Therefore, the nasal treatment is of paramount importance, and the nose should be sprayed with ordinary solutions; for example, Dobell's solution and the like, and the nasal mucous membrane touched with compound tincture of benzoin, or iodoform may be insufflated into the nasal passages. Often operations are required for the removal of adenoids or enlarged turbinals in order to complete the cure.

The best hygienic surroundings must be obtained, and, if possible, the child should be given the advantage of fresh air, away from city surroundings, and the strictest attention should be paid to the diet.

Internally, cod-liver oil, iron, quinin, and arsenic are acceptable remedies. Constipation must be avoided and intestinal fermentation combated by suitable remedies. If properly treated, phlyctenular keratoconjunctivitis can be readily cured; if neglected or improperly treated it is a stubborn and relapsing disease, and may leave the child with much scarred corneas, seriously impairing visual acuteness. After all irritation has passed away any refractive error should be carefully corrected.

In general terms, it may be said that patients with phlyctenular disease who come to hospitals for treatment secure the best results if they are treated like cases of general or pulmonary tuberculosis; viz., after the patients or the patients' caretakers are instructed as to general living, proper food, etc., they are visited in their homes by one of the class-workers in the social service of the hospital, and are shown how to live and helped to carry out directions. In brief, phlyctenular patients should join the tuberculosis classes wherever they are organized in hospital work.

Ulcers of the Cornea.—They complicate many infectious diseases, and are particularly noteworthy in the exanthemata, especially in small-pox, and in influenza, typhoid fever, and in gonococcal infections of the conjunctiva. The ulcer may be small, single, and represent only a diminutive area of corneal infiltration, or larger and purulent, or, finally, serpiginous or creeping in character; that is to say, an infected or sloughing ulcer. Under the last-named conditions purulent material collects in the anterior chamber in the form of a hypopyon, the iris and ciliary body are secondarily involved, the cornea may perforate, and all the disastrous consequences of this condition arise—namely, thick, adherent scars, the so-called leukomata, staphyloma, and at times infection of the entire eyeball, resulting in phthisis bulbi. Bacteriologic investigation of the ulcers will usually reveal, in the sloughing types, the pneumococcus, sometimes the streptococcus, and sometimes a mixed infection. Many other bacteria, however, have also been found under these conditions. The prognosis of sloughing ulcers is always serious, especially as they occur in small-pox, in typhoid fever, and in measles and scarlet fever.

If they are of small or simple variety, they are readily cured by keeping the conjunctival cul-de-sac clean with a saturated boric acid solution, instilling a few drops daily of an atropin solution, 4 gr. to the oz., outlining the ulcer with fluorescein, and touching the colored area with a mild antiseptic; for example, a 2 per cent. solution of nitrate of silver applied on the end of a probe. If the ulcer is more extensive, the measures must be more radical. Atropin should be instilled with sufficient frequency to maintain mydriasis and combat any coexisting iritis or cyclitis. Occasionally in marginal ulcers the myotics are employed, either pilocarpin or eserin, from $\frac{1}{2}$ to 2 gr. to the oz., but almost always the mydriatic treatment is the preferable one. Vigorous cleansing of the conjunctival cul-de-sac is necessary with boric acid lotion, bichlorid of mercury, 1 : 10,000, cyanid of mercury, 1 : 2000. If abnormal conjunctival secretion coexists, it may be checked by the instillation of a 25 per cent. solution of argyrol or a 10 to 20 per cent.

solution of protargol, but these remedies must be used with care lest they stain the cornea or the conjunctiva.

To prevent the spread of local infection, the ulcer should be scraped with a curet and afterward touched with pure carbolic acid, tincture of iodin, trichloracetic acid, or nitric acid, and, if these measures fail, with the actual cautery, great care being taken that these escharotic substances shall reach only the diseased area, which should be previously outlined with a 2 per cent. solution of fluorescein. An excellent practice is to dust upon the ulcer iodoform and immobilize the lids with a lightly but firmly applied pressure bandage, which is to be removed when the various applications already described are required. If there is an abscess of the lachrymal sac, or abnormal secretion pours from the puncta, the lachrymal canal should be dilated and irrigated with a bichlorid solution, 1: 10,000; often it is necessary to excise the lachrymal sac. It is the practice of some surgeons to check the spread of infection by subconjunctival injections, notably bichlorid of mercury, 1: 4000, cyanid of mercury, 1: 1500, a few minims of these solutions being injected beneath the conjunctiva. In order to produce analgesia and an active lymphagogue action, dionin should be employed, 1 drop of a 5 per cent. solution being instilled three or four times a day in conjunction with the atropin, and continued as long as the so-called dionin reaction occurs, when it may be stopped for a few days, and again repeated. The practice of putting cocain in eyes with corneal ulcers is to be deprecated, except as a temporary anesthetic during the application of severe escharotics. On the other hand, holocain (2 per cent.), applied directly to the ulcer, is sometimes of signal service, and it may be used in conjunction with dionin. In severe cases of hypopyon keratitis it may be necessary to perform paracentesis of the cornea to evacuate the purulent accumulation in the anterior chamber or to perform Saemisch's section.

After the ulcer has healed, and all inflammatory symptoms have subsided, the resulting corneal scars may sometimes be favorably influenced by massage of the cornea after the introduction of a small portion of a salve composed of the yellow oxid of mercury, in the proportion of 1 gr. to the dram of vaselin and by continuing the dionin instillations. If the resulting scar is an adherent leukoma, iridectomy may be required for optical purposes. If a disfiguring staphyloma has formed, it may be necessary to amputate it or to enucleate the eyeball.

During corneal ulceration the nasal passages should be frequently sprayed with Dobell's solution or with permanganate of potassium, 1: 5000, and all secretion from the conjunctiva should be removed by means of frequent irrigations with boric acid solution. The teeth should be carefully examined for necrosis and the gums for pyorrhea. Hot compresses of a temperature of 120° F., frequently applied, are of distinct benefit; sometimes, however, the application of cold, in the manner already described (p. 748), serves a better purpose. The patient's nutrition must be maintained, the bowels regulated, and a tonic regimen ordered if the general condition indicates it. Aspirin and

salicylates are of service if the pain is severe, especially in the presence of a complicating iritis. Opium or codein at night may be required.

In place of active ulceration, ulcerative keratitis sometimes takes on the so-called indolent course, and under these circumstances the treatment need not be so vigorous as that already recited, but the ulcer may be encouraged to heal by the direct application to its surface of absolute alcohol, which is sometimes of great value. Indeed, the indications of this drug are not entirely limited to this type of corneal ulcer. It stands to reason that during ulceration of the cornea the patient's general nutrition must be supported to the fullest extent, according to the indications of the general disease from which he is suffering.

Other severe types of corneal ulceration, which have been mentioned in connection with the description of the ocular signs of the infectious diseases, do not require treatment other than that which has already been detailed; for example, the so-called xerotic keratitis or keratomalacia. The prognosis, however, is always most unfavorable, and the results of treatment extremely unsatisfactory.

The various types of herpes of the cornea, which present themselves usually in the form of a vesicular eruption upon this membrane, which breaks down and forms ulcers which often have a branched or dendritic appearance, usually require for its treatment atropin, boric acid, and careful conjunctival antisepsis. Dionin is of signal service in these cases, and if the ulcer fails to heal, one of the best applications is the tincture of iodin, the exact area to be touched having been determined by coloring the denuded epithelium with fluorescein. Subsequent massage with the yellow oxid of mercury ointment is of advantage.

Non-ulcerative Forms of Keratitis.—These may be superficial, that is to say, the infiltration is in the anterior layers of the cornea, or they may be deep, that is to say, the infiltration attacks the true parenchyma of the cornea, and the disease is then known as interstitial or parenchymatous keratitis.

Interstitial keratitis of syphilitic origin is the most important under the present consideration. Most frequently it is due to inherited syphilis, and is seen especially between the ages of five and fifteen, manifesting itself in a progressive opacification of the cornea, which soon takes on the appearance of ground glass, associated with vascularization of its edges and secondary involvement of the uveal tract. It is a disease of long duration, practically always bilateral, although both eyes are not always affected at the same time, and requires from six to eighteen months for the development of its various stages. All irritating applications are contra-indicated. Atropin to maintain mydriasis and prevent iritis should be systematically employed, provided there is no rise of tension owing to the development of secondary glaucoma. Mercury administered by inunctions is of great service, and should be systematically employed, a dram daily, as long as it is well borne. Later the patient may be put upon a course of iodid of potassium, with or without bichlorid of mercury. Anemia should be combated with iron and arsenic, and the best possible general hygiene should be secured. The disap-

pearance of the opacities in the cornea is materially facilitated by the use of dionin, and later by massage of the eyeball with the yellow oxid of mercury ointment. Finally, subconjunctival injections of physiologic salt solution are often valuable. Occasionally the development of secondary glaucoma requires operative interference—iridectomy or paracentesis of the cornea.

Not all of the cases of interstitial parenchymatous keratitis, however, are due to syphilis, as the disease may be caused, as has already been noted, by tuberculosis, scrofula, malaria, rheumatism, and depressed nutrition. The treatment does not differ from that already described, except that in place of mercury the remedies suited to the constitutional condition, which is the underlying cause of the corneal disease, must be exhibited. Injections of tuberculin "T. R." are of value in those cases depending upon tuberculosis.

TREATMENT OF DISEASES OF THE SCLERA

Episcleritis or Scleritis.—In a certain number of infectious diseases, as already recorded in the preceding paragraphs, the ocular complication consists of an inflammation of the episcleral tissue or of the sclera itself. This is particularly true in rheumatism, influenza, and tuberculosis. The disease may appear in the form of dusky red, subconjunctival swellings, unassociated with abnormal conjunctival secretion, or in diffuse bluish-red injections of the sclera, and sometimes in a form which has received the name "fugacious episcleritis," characterized by patches of injection, which appear and disappear at intervals. As the iris may be involved in these cases, the use of atropin or scopolamin is often necessary, but in the absence of inflammation of the iris or ciliary body, pilocarpin, $\frac{1}{2}$ to 1 gr. to the oz., is of service. Subconjunctival injections of salt solution are useful and dionin is often of great value. The most important remedies, however, are those indicated by the general disease, notably the various preparations of salicylic acid, aspirin, and, if the patient's general condition permits it, diaphoresis by means of cabinet baths or with pilocarpin. Injections of tuberculin "T. R." are of value if tuberculosis is the etiologic factor.

TREATMENT OF DISEASES OF THE UVEAL TRACT

Iritis and Iridocyclitis.—Involvement of the iris and ciliary body is common in many infectious diseases, as has already been noted, and the salient symptoms are present; namely, ciliary injection, irregular pupil owing to the formation of posterior synechiæ, discoloration of the iris, and the formation of exudations within the pupil space and in the posterior chamber. It should be remembered that the condition of the pupil, which can readily be examined by oblique illumination, distinguishes iritis from other inflammatory diseases of the anterior portion of the eye, and from glaucoma, for which it is sometimes mistaken; also in glaucoma there is rise of intraocular tension.

The treatment is both local and constitutional. First, mydriasis

should be maintained, and the posterior synechiæ pulled loose by means of atropin or other suitable mydriatic. Atropin drops, 4 gr. to the oz., should be used with sufficient frequency to secure this result, and generally it is necessary to instil 1 drop of the solution every three or four hours, taking care by compressing the tear-duct that the fluid shall not run into the nose and from there into the throat. As atropin is not always well borne by the eyes, it may be necessary to use other mydriatics; for example, scopolamin hydrobromate, 2 gr. to the oz., hyoscyamin sulphate, 2 gr. to the oz., daturin, etc. Pain may be allayed by hot fomentations or dry heat, and, if the general condition permits it, by blood-letting from the temple, either by means of Swedish leeches or wet cups. Some surgeons believe that the hot applications are more efficient if the pad of surgical gauze is steeped in lead-water and laudanum. The temperature of the water or of the laudanum-water should be as great as can be borne by the skin of the eyelid, usually from 105° to 110° F. Dry heat may be applied by means of a Japanese stove or hot box. Dionin used in the manner already described, either by itself or in conjunction with the atropin, is indicated. Some relief may be obtained by rubbing the brow with an ointment of mercury and belladonna.

The mydriatic treatment should continue until all of the inflammatory symptoms have subsided, unless it should produce, as it sometimes does in certain types of serous iridocyclitis, rise of intraocular tension. If the congestion in iritis is not too great, subconjunctival injections of physiologic salt solution and of cyanid of mercury (1 : 5000) are often of great value. The mercurial subconjunctival injections may be rendered practically painless by adding a few drops of a 1 per cent. solution of acoin to the fluid. Naturally, the conjunctival cul-de-sac should be kept in a clean condition by frequent irrigations with boric acid or similar mild antiseptic lotions. All irritating applications are to be avoided.

The local treatment of iritis is not sufficient, and the cause of the disease must be ascertained and suitable internal remedies must be prescribed. If syphilis is the cause, the usual remedies, especially as they are detailed on p. 468, should be used, notably protiodid of mercury, mercurial inunctions, and mercury by the hypodermic method. If rheumatism is the etiologic factor, salicylate of sodium in full doses, 60 to 80 gr. per diem, is of great value. In its place aspirin may be used, although I have not found it of as much value as the salicylates. Iodid of potassium, iodid of sodium, and bichlorid of mercury are also exceedingly valuable, and in some types of the disease, particularly in that produced by gonorrhea, great relief follows profuse sweats by means of pilocarpin or with the aid of cabinet baths. If there should be great rise of tension, as occasionally occurs, paracentesis of the anterior chamber may be necessary, and in forms of chronic or recurrent iritis iridectomy is occasionally performed. Tuberculous iritis should be treated with injections of tuberculin, and gonococcic vaccines are of value in gonorrheal iritis.

Uveitis, choroiditis, and retinochoroiditis, when due to syphilis or to tuberculosis, must be treated constitutionally with the remedies which experience has taught control the influence of these infections, notably the iodids, mercurials, and tuberculin injections. If the ocular lesions are active, the eyes should be protected with dark glasses and the pupils dilated with atropin drops. Locally, dionin may be needed; hot compresses are often of value, and diaphoresis aids in the absorption of the choroidal and retinal exudations. Uveitis and choroiditis may be due to, or be aggravated by, intestinal auto-intoxication. If so, the treatment should include thorough intestinal antisepsis and regulation of the diet, determined in the usual manner. Should panophthalmitis or metastatic ophthalmitis arise, treatment, in so far as saving the eye from destruction is concerned, is usually unavailing. Continuous iced eye-packs will sometimes relieve the pain (hot compresses are preferred by many surgeons), and incision into the eyeball may be necessary to evacuate the pus. Generally, however, the eyeball must be removed, and in most instances evisceration is a safer operation than enucleation.

Retinal Hemorrhages.—These, as has been noted in foregoing paragraphs, are a complication of a number of infectious diseases; for example, typhoid fever. If they occur during the activity of the infection, specific treatment for the purpose of facilitating their absorption necessarily must be governed by the condition of the patient. If permissible the iodids, especially the iodid of sodium, are indicated, or in its place syrup of hydriodic acid may be employed. Should the arterial blood-pressure be too high, nitroglycerin may be ordered, and diaphoresis is also useful in encouraging the absorption of the blood extravasation. Exactly the same treatment is indicated in *vitreous hemorrhages* and *opacities*, which, as has been shown, may complicate or follow certain infectious diseases, notably influenza and syphilis. According to some authors, vitreous opacities are amenable to electric treatment. S. Lewis Ziegler recommends *positive galvanism*, the sittings to be given daily or on alternate days, ten minutes at a time, with a 1 m. a. current. He also advises the same treatment in iritis, iridocyclitis, choroiditis, and uveitis, and reports good results in subretinal and retinal hemorrhages. If stimulation is required—for example, in optic nerve atrophy—negative galvanism is indicated, according to the same author.[1]

Optic Neuritis, Retrobulbar Neuritis and Optic Nerve Atrophy.—If optic neuritis is of syphilitic origin, the usual remedies are required, and should be vigorously administered. Optic neuritis (choked disk), the result of increased intracranial pressure—for example, in brain tumor—is best managed by decompressive trephining. On general principles the iodids and mercurials are usually given, and in retrobulbar neuritis, especially as this occurs in influenza and rheumatism, these remedies are useful, as are also diaphoresis and catharsis. Salicylates are also indicated, especially in rheumatic types of the affection. In retrobulbar neuritis complicating influenza care must be

[1] Journal of Advanced Therapeutics, May, 1907.

taken to investigate the nasal accessory sinuses, especially the ethmoid, as the source of infection may proceed from them, and good results will not follow until they are brought into a healthy state. Optic nerve atrophy should be treated with strychnin, preferably by the hypodermic method, sometimes with iodids and mercurials in the early stages, although they are of little service in advanced periods, and with negative galvanism and high-frequency currents. I have never seen a good result from the so-called intermittent *x*-ray flashes, which have been advocated. I have no experience with, nor faith in, the administration of nitrate of silver, phosphorus, arsenic, lactate of zinc, hypodermics of antipyrin, and injections of organic liquids, which at various times have been recommended.

AFFECTIONS OF THE INTERIOR AND EXTERIOR OCULAR MUSCLES

Postfebrile feebleness of accommodation is of frequent occurrence. At the proper time suitable glasses should be provided, and the local use of weak solutions of hydrochlorate of pilocarpin (gr. $\frac{1}{6}$–$\frac{1}{2}$ gr.–f℥j) are useful. Paresis of accommodation, especially common after diphtheria, should be treated in the same manner, and strychnin should be administered internally. If the exterior ocular muscles are involved, the annoying diplopia may be stopped by causing the patient to wear a blinder over the affected eye, or by covering it with a ground glass sufficiently opaque to shut out the rays of light. Usually the administration of the iodids and of mercury is of service under these conditions, and both galvanism and faradism have been tried, but the results are not encouraging. As the muscle or muscles improve it may be possible to relieve diplopia with suitably adjusted prisms, and these are also useful for the relief of residual paresis of an exterior ocular muscle palsy. Not infrequently after illness, notably the fevers, eyes previously apparently normal become asthenopic, and suitable glasses must be ordered. It is always proper to reinvestigate the refraction of eyes after illness, especially after certain fevers—for example, typhoid fever—as it may be found that this has changed and an alteration in the patient's glasses is required. Many postfebrile headaches are due to this cause.

SPECIAL LINES OF TREATMENT

The immunization treatment of infectious diseases, in so far as their ocular manifestations are concerned, has proved to be of great value, especially in tuberculous affections of the eye.

Tuberculosis of the Eye.—As has been recorded on previous pages, certain varieties of parenchymatous keratitis, phlyctenular keratitis, scleritis, sclerokeratitis, iritis, uveitis, and choroiditis are due to tuberculosis, and in their treatment various tuberculins are employed. For therapeutic purposes tuberculin "T. R." and bouillon filtrate "B. F." (Denys), are more efficient than tuberculin "T. O." (Koch's original tuberculin). The last variety is often used for diagnostic purposes.

In the administration the plan of von Hippel may be followed with satisfaction; viz., using tuberculin "T. R." the initial dose of $\frac{1}{5000}$ mg. is gradually increased by the same amount to $\frac{1}{500}$ mg. and even to $\frac{10}{500}$ mg., the dose being given every third day, and less frequently as improvement in the ocular condition is noted. Sometimes it is necessary to increase the dose from $\frac{1}{5}$ to $\frac{5}{5}$ mg.,—*i. e.*, to 1 mg. by $\frac{1}{5}$ mg. at each injection. The dose should be regulated so that a general reaction is avoided; the amount administered may be increased as occasion requires and as the treatment continues, but should not exceed 1 mg. Bouillon filtrate, obtained from the Saranac Laboratory, is very active, and the initial dose of $\frac{1}{10,000}$ of a mg. is recommended by G. S. Derby (this is equivalent to about $\frac{1}{1000}$ of a mg. of "B. E.," or bacillus emulsion). The dose is gradually increased, but is usually not made to exceed 1 mg.

I have also used, especially in tuberculosis and sclerokeratitis, with satisfaction serial dilutions of tuberculin "old." The five dilutions contain respectively 1 : 1000 mg., 1 : 100 mg., 1 : 10 mg., 1 mg., and 10 mg. The dose of each dilution is 2 min., and is progressively increased until 20 min. are injected. Following this, the next series is begun. The injections may be made into subcutaneous tissue of the arm, abdomen, or subscapular region. During the tuberculin treatment the local remedies which are indicated should be continued; for example, atropin in iritis, etc. Of the value of this treatment there can be no doubt, and by means of it many eyes have been saved which before its introduction would not have recovered.

Gonococcic Infections of the Eye.—To the treatment of gonorrheal iritis by vaccines reference has been made, and there is no doubt that the vaccine or, more accurately, the bacterin, is sometimes efficient, as it was in a patient in my service in the Philadelphia General Hospital, whose case history has been reported by Dr. Edward Shumway.[1] This patient, suffering from gonorrheal iritis, unavailingly treated in the usual manner, recovered completely after three injections of Neisser bacterin, 100,000,000 organisms having been introduced into the system on each occasion, at three-day intervals. According to John Weeks, who also reports successful treatment of gonorrheal iritis with bacterin, large doses of gonococcus vaccine are well tolerated, but the present tendency is to give smaller doses; these may range from 2,500,000 to 50,000,000.

Gonococcic serum (serum of Rogers and Torrey) has also been employed in gonorrheal iritis (A. Knapp) and in a few cases in gonorrheal ophthalmia. It is not as efficient as the bacterin in the iritic complications and of doubtful value in the conjunctival affections, which must be managed in the manner already described.

Diphtheritic Infections of the Eye.—As has already been noted, the most efficient treatment of diphtheritic conjunctivitis is by means of diphtheria antitoxin. According to the age of the patient and the severity of the infection, the initial dose should be from 1500 to 5000 units. Usually two injections are sufficient, repeated at twelve and

[1] Annals of Ophthalmology, 1910, vol. xix, p. 233.

twenty-four-hour intervals; but in the event of tardy improvement a third and even fourth injection should be given (Weeks).

An interesting observation of Darier, Zimmermann, Fromaget, and other surgeons is the occasional value of antidiphtheritic serum in the treatment of sloughing ulcers of the cornea which are not diphtheritic in origin.

Pneumococcic and Streptococcic Infections of the Eye.—Römer, believing that 95 per cent. of infected or so-called serpent ulcers are caused by the Fränkel-Weichselbaum diplobacillus, has, with the aid of the chemist Merck, developed a serum (*pneumococcus* or *antipneumococcus serum*) which he advises in the treatment of this form of corneal disease. The serum may be used subcutaneously and may be instilled into the conjunctival sac. Römer himself doubts the value of the subconjunctival injections. Subcutaneously from 3 to 5 cc. of the serum may be employed, and the results thus far reported indicate that occasionally it seems to facilitate the cure of beginning ulcers, but in large, well-developed ulcers it is ineffectual (Zur Nedden). Complications have been reported; for example, myocarditis and decided febrile reaction are said to have followed the injections (Zeller). According to Axenfeld, this serum possesses curative properties, but, as prepared at present, its action is not sufficiently certain to allow it to replace other methods.

The antistreptococcus serum or vaccine has also been employed in streptococcal infections, but apparently it, like the antipneumococcus serum, should be regarded as supplementary to other forms of treatment. Of staphylococcus serum-therapy too little is known to determine its influence on the eye (Axenfeld).

I have most successfully treated one patient, with extensive infected ulcer of the cornea (hypopyon keratitis), which yielded a pure culture of streptococcus mucosus, with a bacterin prepared from this organism for me by Dr. B. A. Thomas, three injections, one containing 50,000,000 and two containing each 100,000,000 organisms having been administered. In postoperative infections treatment with Wright's antistaphylococcus vaccine has occasionally proved to be efficacious, and in recurring hordeola a bacterin, prepared from the organism which is active, has been suggested as a method of treatment worthy of trial.

THE AURAL COMPLICATIONS OF THE INFECTIOUS DISEASES

By Charles W. Richardson, M. D.

EPIDEMIC INFLUENZA

In the winter of 1889–90 epidemic influenza made its appearance throughout the world, it being the first manifestation of this infectious disease in an epidemic form in the present generation. Invasion, year after year, has followed with varying degrees of percentage of aural complications. The character of the complication, both as to its severity and the area of the auditory tract involved, has shown variability in the different years. It is a mooted question whether the aural complications of the disease are due to the action of the specific organism, or whether the toxins of this disease simply render the tissues of the aural tract more vulnerable to the usual types of pathogenic organism, producing similar conditions not influenzic in character. Sheibe has demonstrated in the exudation a bacillus which has the characteristics of Pfeiffer's bacillus. Clinically, the otitic complications of influenza do not differ in any way from the same condition when not a complication of the infectious disease, except as to their intensity and the more frequent involvement of the mastoid in the suppurative type; therefore, it is more than probable that the bacillus, by its presence, simply intensifies the action of the usual pathogenic microörganism. When the toxic elements exert themselves more actively upon the upper air tract, we have those infections of the sound-conducting tract; when upon the nerve center, we have those affections of the perceptive apparatus. The most frequently observed microörganisms in the discharge are the streptococcus pyogenes, the staphylococcus, the diplococcus, and the pneumococcus. The external auditory apparatus is occasionally the seat of a circumscribed or diffuse inflammation; more frequently than the above-mentioned condition is a vesicular eruption in the canal and on the surface of the membrana tympani. The vesicles may contain clear serum, but more frequently are hemorrhagic. This change is, in all probability, a trophoneurosis.

Changes observable in the conducting apparatus are by far the most frequent and serious in their character in influenza epidemics. These changes are either in the form of acute catarrh, acute inflammation, or suppurative inflammation. In different years the predominance of the particular type, or, rather, the severity of the change within the middle ear, varies greatly. The differentiation of the acute inflammation from

the suppurative inflammation in influenza is extremely difficult, and I have always considered it best in this disease to treat the two conditions as though each were the severer type of infection—to err, if error be made, on the side of safety. One of the marked peculiarities of a suppurative middle ear as a complication of influenza is its proneness to be attended with infection of the mastoid antrum and cells, and the often rapid and extensive destruction of the mastoid cells when participating in the infection. I have on several occasions found the mastoid cellular structure completely disorganized and filled with pus as early as seven days after the initial ear symptoms. The affections of the perceptive apparatus are either in the nerve trunk or in the labyrinth. In all probability it is a circulatory change. There is also a form of perceptive change, which, for a better name, is called auditory fatigue. This condition is characterized in that prolonged fixed attention is attended with gradually increasing impairment of function. It is, in all probability, an auditory nerve lesion. With appropriate treatment, early instituted, most cases of the otitic complication of influenza should make a good recovery with complete restoration of function.

TYPHOID FEVER

From the fact that a large percentage of typhoid patients are subject to impairment of hearing during the progress of the disease, from which there is usually complete recovery with convalescence, has led most practitioners to become indifferent to the fact that disease conditions do take place in the auditory apparatus during the continuance of typhoid, which not only may lead to serious impairment of the function of audition, but to actual danger to the life of the patient. The deafness in typhoid fever is no doubt most frequently to be explained in the non-tympanic cases by the active poison on the cerebrum itself. Politzer, Day, Jackson, and others, from the fact of the presence of tinnitis in many of the non-tympanic cases, believe that the action of the toxins is upon the terminal nerve distribution in the labyrinth. As deafness is so frequently present in typhoid fever, and as destructive changes usually take place without pain, careful and frequent examination of the ears in typhoid should be made, in order to ascertain when the auditory symptoms are centric and how far they are due to local changes within the auditory appendages. The character of the pathogenic changes in typhoid are not unlike those occurring from simple types of infection, and the clinical history does not differ much from the simple otitis. Some investigators state that they have demonstrated the typhoid bacillus in the exudate from the auditory canal and also in the pus from the mastoid cells. It has been demonstrated by Prochaske, Peysing, and Coplin. The most frequent pathogenic organisms in the infective form of middle-ear complication of typhoid fever are the streptococcus, staphylococcus aureus and albus, pneumococcus, and bacillus diphtheria. The relative frequency of the occurrence of rare complications in typhoid fever are subject to the changes which we note

in all the acute infectious diseases. In some years they are more pronounced than in others, and they bear a direct relationship to the virulence of the disease. Bezold, in von Ziemssen's clinic in Munich, saw 1243 cases of typhoid fever, with 41 suppurative and 9 tympanic catarrhs —$3\frac{9}{10}$ per cent. Others report a varying percentage, ranging from 11 per cent., as reported by Day and Jackson, to 2.1 per cent., as reported by Osler. I should judge that the average, as obtained from a number of statistics, is about 4 per cent.

The manner of invasion of the infection is, without doubt, due to direct extension of nasopharyngeal inflammation by continuity through the Eustachian tube, direct conveyance of septic material through the tube into the middle ear, and embolism in the mucous membrane.

The invasion of the ear, especially of the suppurative type, usually takes place after the third week of the disease. Typhoid fever produces changes within the auditory canal, middle ear, and labyrinth. In the auditory canal we have the acute, circumscribed abscess, an exceedingly rare complication. In the middle ear we have the simple catarrhal and suppurative inflammation. According to Day and Jackson, suppurative inflammation in the middle ear, as a complication of typhoid fever, assumes three forms, viz., the hemorrhagic, the slow, and the fulminating. If the general toxemia is great, there is no pain; when toxemia is not marked, pain is great. The labyrinth is also affected by the toxin in typhoid fever, as characterized clinically by deafness without evidence of inflammation in tympanic membrane or tympanum.

The prognosis in the aural complications of typhoid is favorable as to life as well as to the restoration of the auditory apparatus to the normal condition.

MEASLES

Measles is unlike scarlet fever in producing extensive destruction of the membrana tympani, exfoliation of the ossicles, and caries and necrosis of the tympanic walls, with involvement of the labyrinth. In fact, measles can be considered, of the infectious diseases, the mildest in its destructive changes in the auditory tract, although involvement of the ear in measles is next in frequency of occurrence to that of scarlet fever. The frequency of the manifest changes in the auditory apparatus in measles is placed at about 10 per cent. There is no doubt in this disease, as well as in others of the infectious diseases, if all cases were carefully examined as to the state of the auditory apparatus, the percentage of infectious reports would be somewhat greater. Several otologists have followed out this line of investigation, and have found that many children affected with measles have objective, demonstrable lesions of the middle-ear cavity without having given subjective evidence of these lesions.[1] Those children having adenoids at the time of the infection are very prone to the aural complications; also those children developing the pulmonary complications during the attack are especially susceptible

[1] Robert H. Woods states that 40 per cent. of cases examined by him showed objective signs, recovering after a variable time without rupture of the membrana tympani.

to infection of the middle ear. Enlarged tonsils and adenoids probably have as much to do with the occurrence of otitis in measles as the severity of the infection.

The mucous membrane of the auditory tract, as well as the pharynx, partakes of the general catarrhal condition and eruption of the exanthem. The general poisoning of the blood also affects the auditory apparatus in measles, as it does in the other acute exanthem. Tobertz, Moos, Bezold, and Seibermann have demonstrated to the sufficiency in the examination of children dead from measles, who manifested no symptoms in connection with the ear during life, that in nearly every case exudation existed in sufficient quantity in the middle-ear cavity to be observable to the unaided eye, usually filling the entire cavity. The exudation was largely made up of pus-cells, and contained one or more of the pyogenic microörganisms. In many of these cases, especially those of early infection, there was no change whatever in the Eustachian tube, evidencing that the infection must have been produced through the action of the general poisoning. Bezold states, from the results of his investigation, that we are justified in considering that acute otitis suppurative media is, from the frequency with which it is demonstrated by the post-mortem examination, as much an integral part of the infection of measles as the conjunctivitis, rhinitis, pharyngitis, and bronchitis.

The infective microörganisms usually found in the exudate in measles are streptococcus pyogenes, the staphylococcus aureus, Friedlander's pneumobacillus, and the diplococcus. The usual period of invasion of the ear tract is during the early part of the first week of the general infection, although it may not manifest itself until the second week. The auditory canal is usually exempt from showing any demonstrable change. The middle-ear tract is the area most frequently infected. The changes shown in the middle ear are either in the form of simple catarrh or of the suppurative type. The simple catarrhal inflammation occurs more frequently than the suppurative type. The labyrinth is occasionally infected, and, when involved, usually results in marked impairment of hearing. In measles the infection of the middle ear is more frequently unilateral than is the case in scarlet fever. The prognosis in the otitis of measles is decidedly favorable. All cases of the catarrhal form, under appropriate treatment, should recover, with full restoration of function. The suppurative form, under appropriate treatment, should also recover without complications, restoration of the membrane to the normal, and with normal or nearly normal restoration of function.

VARIOLA

Variola is one of the acute infectious diseases that is rapidly passing out of the observation of the general practitioner, but, as it has, nevertheless, complications in connection with the auditory tract, it deserves more than passing consideration. There is no specific type of infection of the auditory tract in small-pox, if we exclude changes in the external ear. The type of change is that seen as resulting in the otitis, when not occurring as a result of the acute infectious diseases, with the differ-

ence that the exudate is apt to remain apparently without destructive activity longer than it does in the simple infections. The microörganisms usually found present are the streptococcus pyogenes, the staphylococcus, and the diplococcus. The frequency of the occurrence of the complications in connection with the auditory apparatus in small-pox is 7 per cent., clinically noted. It is interesting to observe, also, in connection with this disease, as we have already noted in discussion of the other acute infectious diseases, that the percentage of complications would be greater if all ears were clinically examined. The time of the infection of the ears is usually early in the disease. At the time of pustulation the ear symptoms have usually attained their maximum. At times, especially in the mild type of complications, the invasion of the ears is not manifested until after pustulation. Variolous pustules are seen over the auricle and in the cartilaginous auditory meatus, presenting the same characteristics as they do when appearing elsewhere on the cutaneous surface. In the bony portion of the canal we never have the formation of pustules, although there is noted a swelling and infiltration of the cutaneous lining of this portion of the canal as well as the membrana tympani. In and about the pharyngeal orifice of the Eustachian tube, and within the cartilaginous portion of the tube, we find the same changes as observable in the pharyngeal mucosa, the hyperemic hemorrhage, and swelling and membranous deposition. The most frequent type of involvement of the middle ear is that of a middle-ear catarrh, attended with intense hyperemia and the outpouring of an exudate of a serous or seromucous character. The suppurative type of infection of the middle ear in small-pox is not very frequent in its occurrence. The labyrinth is involved very rarely. The infection of the ears is mild in character, and, with appropriate treatment, should afford a favorable prognosis as to result and restoration of function.

DIPHTHERIA

The invasion of the ear as a result of the infection of diphtheria is not, in its severe type, a very uncommon occurrence. The character of the infection is not as severe in its results as the diphtheroid scarlatinal infection occurring in scarlet fever. In fact, contrary to what might be expected from the severity of the invasion of the pharynx, the extensive deposit and the profound depression produced by this condition, it is rather one of the mildest of the acute infectious diseases in the character of the changes produced in the ear tract. The pathogenic organisms found in diphtheritic invasion of the auditory tract are the Klebs-Löffler bacillus, the streptococcus pyogenes, and the staphylococcus aureus. The relative frequency of the occurrence of changes within the auditory tract, clinically noted, during the invasion of diphtheria is about 5 per cent. If we accept the results of investigations made by the examination of the ears of all those sick of diphtheria in which changes in the auditory apparatus objectively and subjectively were noted, we find 63.3 per cent.[1]

[1] Lewin, Archives für Ohrenheilkunde, Bd. 52, S 219.

The result of autopsies give in this infection, as in other of the acute exanthemata, practically the same conclusion—95 per cent. of infection of the auditory apparatus. Lomuel concludes from his autopsies that otitis media forms a feature of diphtheritic involvement of the upper air tract.[1]

The result of the finding of autopsies in this affection would seem to demonstrate that the ear was much more frequently affected than is recognized clinically. We must recognize the fact, however, that it is only the most severe cases that come to autopsy, and, therefore, we cannot draw from them absolute conclusion as to frequency of aural complications.

If we must accept that these changes are so frequent as demonstrated by autopsy then many must clinically, in the living, pass through the successive changes without manifesting symptoms, and in the majority of the cases resolve without impairing the integrity of the auditory apparatus.

The infection of the auditory tract, as evidenced by objective signs, occurs in diphtheria very early, often with and even before the local changes within the nasopharynx. The method of infection is evidently twofold—either indirect, through the circulation or lymphatic system, or directly from the pharynx, through the Eustachian tube. There is, in all probability, a mild, simple type of otitis excited by the general action or the specific poison, while those forms of infection, excited by direct transmission of the virus from the pharynx through the Eustachian tube, are of a specific nature, and, therefore, more severe and destructive in their nature.

Diphtheria, like scarlet fever, affects all portions of the auditory tract. Primary and secondary diphtheritic exudations are found in the auditory canal, the primary type usually being present with imperforate membrana tympani, the exudate covering the outer surface of the membrane, filling out the auditory canal, and extending on to the concha and tragus. The secondary type usually follows the diphtheritic invasion of the tympanum, and in this form we may have erosion of the concha and auricle. The membrane formed has the general appearance and follows out the clinical history of the diphtheritic membrane wherever found.

The infection of the middle ear may be either in the form of a simple catarrh or of a suppurative otitis media. The suppurative inflammation is most frequently of a simple type, and, therefore, mild in its course, and terminating in recovery with restoration of function; occasionally it is specific in type, attended with the formation of the characteristic exudate, destructive in tendency, and leading to serious organic lesions and death. Pain in suppurative inflammation of the middle ear is a more pronounced symptom than in the same condition occurring in the other exanthematous diseases.

Internal Ear.—The labyrinth does not seem to be especially vulnerable to the invasion of the poison of diphtheria. It is otherwise with the

[1] Zeitschrift für Ohrenheilkunde, Bd. xxxix, S. 301.

auditory nerve; this nerve is that part of the perceptive area of the auditory apparatus which seems especially susceptible to the action of the diphtheritic virus.

SCARLET FEVER

The infection of the ear as a result of the invasion of scarlet fever is not due to the activity of any form of microörganism, as one or more of these agents may be present in the exudate in any single case, and another form alone or predominating in the exudate in another case. The microörganisms usually found in this condition are the streptococcus pyogenes, the staphylococcus pyogenes albus, the diplococcus, Friedländer's pneumobacillus, and rarely the Klebs-Löffler bacillus. The relative frequency of invasion of the auditory tract as a complication or sequela to scarlet fever is extremely difficult to reach with any positive degree of accuracy. This is largely due to the fact that the milder types of invasion of the auditory tract are either overlooked or not considered worthy of note. The occurrence of infection of the auditory tract in 20 per cent. of all cases of scarlet fever does not seem to be great. When we take into consideration the proportion of deaf-mutism, due to the destructive activity of the scarlet fever invasion of the auditory apparatus, to the total number of deaf-mutism from all causes, we must acknowledge that the percentage above given is not too great. Burkhardt-Merian reports, of 4309 cases of deaf-mutism drawn from various sources, 445 of these to be due to the ravages of scarlet fever, about 10¼ per cent. Wilhelm, Hartmann, and Hedinger found also the same percentage in deaf-mutism due to scarlet fever. Lemecke found 24.4 per cent. of deaf-mutism due to scarlet fever, and Ucherman, whose observations were solely made in Norway, found the percentage of deaf-mutism due to scarlet fever to be 27.4 per cent. of the whole. The percentage of lesion of the ear due to invasion of scarlet fever to the whole number of ear cases presenting themselves for treatment is 5 per cent., as drawn from the computation of Burkhardt-Merian, Yearsley, Schmaltz, Bürkner, and Blau. All these well-established, statistical facts not only indicate that the aural complications of scarlet fever are quite frequent, but also that they are most obstinate. It is also a well-established fact that the aural invasions are the most frequently occurring complications of the many to which this disease gives origin. The results of autopsies made upon the aural apparatus of children dead from scarlet fever also furnish interesting results with regard to the frequency of invasion of these structures, although frequently no lesion being noted in these organs before death. Bernard von Goessler and others have observed in autopsies that the middle ear, or labyrinth, is affected in most all of these cases, although perforation of the tympanum may not have taken place. It is impossible to take up the consideration of the showing of the autopsies in this article, excepting to state that the autopsies necessarily occurred in the most severe forms of scarlet fever, the death occurring probably before the ear lesion had time to make local external manifestation, and that it demonstrates the probability that

many cases of concurrent involvement of the auditory apparatus take place without being recognized during the period of invalidism.

The method of invasion is either through the lymphatic and vascular system, through the Eustachian tube from the pharynx, or as a result of the lowering of the general condition through the exhaustion produced by the disease. In the first class are those cases of independent involvement of the labyrinth, early and great destruction of the structure of the middle ear, and cases of panotitis occurring before any marked changes in the pharynx are manifested. Autopsies demonstrate in this class of cases the absence of changes within the Eustachian tube. In the second class we find those involvements of the middle ear occurring at the end of the first week of the disease. In the third class are those affections of the middle ear occurring during or after desquamation and the changes within the external auditory canal.

Scarlet fever affects all parts of the auditory tract. The most innocent types are the involvement of the auditory canal. In the canal we may have acute circumscribed abscess, usually affecting the cartilaginous portion of the canal. We also occasionally have the outpouring of purulent material from the auditory canal as the result of the opening of a throat or parotid abscess into the auditory canal. Scarlet exanthemata may involve the auditory canal, being attended during the period of desquamation with the filling up of the auditory canal with the desquamated cells, producing characteristic symptoms. The changes attendant upon involvement of the middle ear are either catarrhal or suppurative, varying in severity according to the character of the invasion. The changes within the internal ear are most frequently the simple or destructive changes of the labyrinth. Added to these we have also those severe types attended with simultaneous suppurative changes within the middle ear, labyrinth, and mastoid cells, which are designated cases of panotitis. The severe types of suppurative changes in the middle ear and panotitis are apt to be attended with other severe complications, especially in connection with the kidneys.

In other of the infectious diseases than those individually defined above, the ear may be affected as a complication, but, when such infection is present, it assumes the character of such lesions as occurring primarily, and is in no way affected in their origin or course by the infection of which they form a complication. It is expedient to direct special attention to the occurrence of involvement of the internal ear as a complication of mumps. This complication occurs from the third to the eighth day, or as the disease subsides. This invasion occurs suddenly, and is characterized by the usual type of symptoms, such as loss of hearing, tinnitus, giddiness, staggering gait, pain in forehead, occiput, and vomiting. Temperature may be present. In tuberculosis we may have any of the usual aural affections; the most frequent complications are the middle-ear catarrh and suppuration. The catarrhs are obstinate, and usually progress to marked impairment of the hearing. The suppurations are attended with a painless course, frequently multiple perforations, and are very obstinate. It is a mooted question whether

the bacillus tuberculosis is a pathogenic agent or is simply present as an accidental factor. The infection of the ear is said to occur primarily, but no doubt occurs most frequently secondarily to infection of the respiratory tract. Infection of the ear in tuberculosis may take place through the vascular or lymphatic systems or through the Eustachian tube.

TREATMENT OF THE AURAL COMPLICATIONS OF THE ACUTE INFECTIOUS DISEASES

The essential and most important feature in the treatment of any condition is the thorough study of the condition present, its diagnosis, a thorough conception of its various present and possible clinical phases, and its pathology. In the treatment of the various aural complications of the infectious diseases it is essential that the general practitioner be more thoroughly aroused as to these essentials in connection with the aural complications, and also as to the importance and necessity of making aural examinations in all cases of the infectious diseases wherein aural complications are liable to occur. All practitioners who are brought into frequent contact with the acute infectious diseases should render themselves thoroughly conversant with the methods of examination of the aural appendages in all details, and should have a sufficient clinical knowledge of the common ailments of these organs so as to be able to readily diagnose them, or seek the aid of a skilled otologist to make these examinations for them in their infectious cases. In all cases where there is the slightest suspicion of complication on the part of the auditory tract, unless the practitioner is thoroughly competent, he should seek competent aid. It is to be hoped that the otologist, in the near future, will not be confronted with the doubting question, which is now too often put to him by the general practitioners of undoubted skill, "Is it possible that this rise of temperature can be due to the ears, or is the sudden change in the general condition possible as a result of the aural complication?" The general practitioner, making aural examination, should be impressed with the importance, in his examination, of good illumination; the thorough exploration of the external ear and canal before the introduction of the speculum; the thorough adaptability as to the size of the speculum to the canal of the ear; and that in infants, to obtain a view of the membrana tympani, it is necessary to draw the auricle gently downward and backward; in older children and adults, upward, backward, and outward. When the auditory canal contains loose epithelial cells or collection of serum around the circumference of the meatus, they should be removed by gently syringing the canal with warm, sterile water before inspection is attempted, as it is always desirable to have a perfectly clear canal to obtain an unobstructed view of the membrane. One should be careful not to mistake the white, partially exfoliated epithelial layer for a normal membrane. When the membrane appears abnormally white, it should be gently brushed over with a cotton wound-probe, when, if the

condition is due to exfoliated epithelial layer, the congested membrane will be revealed. All treatment should be employed that will lessen the severity of the general infection and the activity of the toxin. In the diphtheritic infection, whether simple or in combination with other infectious diseases, as scarlet fever, the antitoxin of diphtheria should be early and liberally administered. As the presence of enlarged tonsils and the existence of adenoid growths in the pharynx render children more susceptible to the aural complications in the infectious diseases, these conditions should always be removed as a preventive measure in all children so affected.

As the upper air tract is more or less infected in all the acute infectious diseases, treatment should be at once directed to these parts, in order to lessen the probability of infection being conveyed through the tubes to the middle ear. Siegfried Weiss has demonstrated that even the mild treatment that he instituted during an epidemic of measles to the nose and nasopharynx lessened the infection of the middle ears quite considerably. In infected nasal and pharyngeal cavities due caution should be exercised in the clearing of the nasal cavities, that too much force should not be used in the blowing act. Those patients not knowing the proper method of the nasal toilet should be taught the proper method. In measles, scarlet fever, diphtheria, whooping-cough, variola, and epidemic influenza, occurring in adults and older children, the nasal cavities or pharynx should be thoroughly cleansed once or more daily, according to the amount of exudate, by mild, detergent, alkaline, carbolized sprays. Before making use of these agents, it is well to examine the nasal cavities, in order to ascertain their conformation and as to what pathologic changes may be present, as conditions may be present which would require the direction of the spray to be modified or contraindicate its use. The spray should be directed through the more roomy cavity, and with great gentleness through the restricted cavity. The spraying should be directed horizontally, due care being exercised not to spray against the septum or anterior extremity of the inferior turbinate. Only the oral pharynx should be cleansed, and due care should be exercised here against producing retching. The spray should be supplied only with the straight tip. The make-up of the solution is indifferent, excepting that it be bland, non-irritating, and accomplishes the purpose. Normal saline solution, or the solution made by the dissolving of the tablets known as the nasal plasma tablets of Dr. Murray Macfarlane, answers admirably for the purpose. A solution which I frequently use is as follows:

℞. Acidi carbolici ..... ♏vj
Sodii bicarbonatis ..... gr. xxx
Sodii biboratis ..... gr. xl
Glycerini ..... ℥ij
Aquæ destillæ ..... ad. ℥vj.—M.

A teaspoonful of a 10 per cent. solution of permanganate of potash in 3 oz. of water is also of value for cleansing. In many of these agents due care should be exercised in their application, and as little disturbance

as possible to the patient should be caused in the treatment. In very young children and infants a great deal can be done along the same line, with no less a formidable instrument than an ordinary eye-dropper with a straight point. The child's head is held firmly between the two hands of a nurse or maid, and the dropper, filled with one of the above solutions, is gently injected into one and then the other nasal cavity. Siegfried Weiss suggests after the cleansing, and, indeed, without it, the installation of a pledget of cotton in the vestibule of the nose, saturated with a ½ per cent. solution of nitrate of silver. The nose is pressed after the cotton pledgets are introduced, and the solution runs back into the nasal chambers. The pledgets are then removed. I should judge that this simple method of applying the nitrate of silver daily after cleansing would be of value in all cases. In typhoid and pneumonia great care should be exercised in the use of the spray, especially when there is marked prostration. In typhoid the cleansing is of great value, not only as a prophylactic measure, but also as a means to remove the crusts and scabs which form in this disease, and which are a source of nasal bleeding. When sprays cannot be used in these conditions, the eye-dropper serves an admirable purpose.

When in the infectious diseases, as in scarlet fever, the canal lumen becomes obstructed with desquamated cells, as indicated by more or less deafness, tinnitus, fulness in the ear, and the physical evidence of the whitish exudate, it is necessary to remove it by gentle syringing of the canal with lukewarm sterile water until all of the exudate is removed. As syringing will not always free the canal of all the exudate, it becomes necessary to pick away the remaining flakes with forceps, or by the gentle use of the dull curet under good illumination.

Diphtheritic or *croupous exudate*, occurring primarily or secondarily, require practically the same treatment. The surface involved should be thoroughly and frequently cleansed, so as to prevent the spread of the deposit. The canal and those portions of the auricle infected should be frequently irrigated, either by the aural piston or fountain syringe, with a warm solution of lime-water. No attempts should be made to forcibly remove the membrane, as it leaves a raw, bleeding surface upon which the exudate will rapidly re-form. A solution of the ferric sulphate in full strength, applied by cotton wound-applicators, is seemingly of value in lessening the activity of the germs and the spreading of the infection. The irrigator should be used from five to ten minutes every four hours, and the ferric sulphate applied once daily after the irrigation.

The *hemorrhagic external otitis* occurs most frequently as a complication of the epidemic influenza. The local condition requires very little consideration, as the vesicles usually rupture and discharge their contents without giving rise to symptoms. When the vesicles form, however, in the deeper canal and on the surface of the membrana tympani, they cause the most exquisite pain until they rupture. This pain can be immediately relieved by opening the vesicles. The opening of the vesicles on the membrana tympani should be done with extreme caution, the patient's head being well supported to prevent movement, so as not to

puncture through the membrane into the tympanum. After the vesicles are opened spontaneously or artificially, the surface should be dusted with some bland powder to protect the denuded areas within the canal.

Circumscribed abscess of the auditory canal occurs most frequently in scarlet fever, influenza, and typhoid, and rarely in other infectious diseases. When tenderness is manifested about the auricle in the infectious diseases, increased by pressure on the tragus or by moving the wing of the auricle, the canal should be carefully examined for tumefaction or localized points of tenderness. As this is an evidence of a physical condition, under the normal physiologic standard, when occurring primarily or secondarily to the infectious disease, I cannot convince myself that local bleeding should be resorted to as an abortive measure. When the cases are seen early, before there is any local evidence of tumefaction, the external application of cold by Leiter's coil or the Sprague ice-bag may arrest the condition. Most frequently we do not see these cases until it is too late to make attempts at abortion. As these abscesses are often deeply seated, it may require from twenty-four to forty-eight hours before they show any indication of their location, during which time we must relieve the pain. At this time we find that the application of heat is most advantageous. This can best be accomplished either through the use of the small Japanese stove or the small hot-water bag. Most of the agents suggested for the relief of pain, in the form of drugs, have no value whatever, and the menstruum in which they are employed causes a maceration of the epithelial lining of the canal, often leading to further infection. If drugs are to be used in combating the pain, as they must be occasionally, I find that the bougies made by the formula of Dr. George L. Richards is one of the best methods of this application:

℞. Acidi carbolici ..... ♏vij
Fluidextracti opii ..... ♏vj
Cocain,
Atropinæ sulphitis ..... āā gr. iij
Aquæ ..... ♏lij
Gelatini ..... gr. xviij
Glycerini ..... gr. clviij.—M.
To make 42 bougies.

The application of a 12 per cent. solution of carbolic acid in glycerin to the canal wall will also greatly ameliorate the pain. Bearing in mind that the process is essentially one of local infection, we must remember that, besides the relief of pain, our efforts must be directed to the prevention of infection of other points in the canal wall. This is best accomplished by the irrigation of the canal with hot carbolic solution (1:60) or bichlorid solution (1:8000), for from five to ten minutes, repeated four or five times daily. The canal should be thoroughly dried with pledgets of sterile absorbent cotton after the irrigation. I find, between the irrigations, the wearing of a pledget of cotton saturated with a 20 per cent. solution of menthol in olive oil is of value, both for its analgesic and antiseptic properties. While the remedies spoken of above are of value,

there is no doubt that the early incision of the tumefied area affords the greatest and most satisfactory relief. Under good illumination and after a thorough localization of the infected area, the tumefaction should be incised with a narrow, sharp bistoury, cutting from within outward. The incision should be made through the periosteum or perichondrium. The operation is an exceedingly painful one, but does not require the use of a general anesthetic. Local anesthesia is of no value. Unless the operation is done thoroughly, deftly, and with dispatch, it is better not to attempt its performance. When the pain of the incision passes off, the relief to the pain is very great, frequently almost complete. I find it advisable, after incision, with or without the evacuation of pus, that it is necessary to keep up the irrigation, substituting warm boric solution for either the bichlorid or carbolic solution. Usually in twenty-four hours the canal begins to assume its normal contour, and this is complete within forty-eight hours. Occasionally granulation springs up about the edges of the incision. These require cureting or touching with chromic acid. Occasionally infection in other portions of the canal takes place and the treatment requires repetition.

Acute Catarrh.—The purposes of the treatment instituted for the relief of this condition are the restoration of the lumen of the Eustachian tube, the promotion of the absorption of the exudate within the middle-ear cavity, and the reduction of the hyperemic and infiltrated mucous membrane of the middle-ear cavity to the normal. The above indications are all met by the use of the air-douche. Only one method of employing the air-douche can be thought of in connection with this affection, occurring as a complication of the infectious diseases, whatever may be the individual preference of the aurist in connection with the disease occurring primarily, and that is an inflation through the medium of the Politzer air-bag. These inflations should at first be employed daily at each treatment. When the improvement of the symptoms lasts over from one treatment to the next, the frequency of the treatment may be gradually decreased to every second or third day, and so on. The improvement is indicated by the gradual absorption of the exudate, the improvement of the hearing, the diminishing of the tinnitus, fulness of ears and autophonia, and the improvement in the general spirits of the patient. In making the inflation, it is immaterial whether the soft palate is made to close off the nasopharynx from the oropharynx by vocalization or through swallowing. In very small children it can be accomplished without either, the crying excited usually being sufficient to produce the desired effect. When the case is progressing satisfactorily under this procedure, it should be borne in mind that the inflations should be carried over a sufficient period of time to insure the absolute restoration of function and the physiologic integrity of the tube and middle ear. It must be constantly remembered that there is no organ in the body which requires so much the helping hand to complete restoration as does the auditory apparatus when once subjected to pathologic changes. In those cases where the effusion is very great, and after the second or third treatment there is no manifest improvement, we may resort to the

use of medicated vapors. Camphor and menthol, in solution of 1 dram to the ounce of alcohol, serve best for this purpose. The vapor is drawn into the air-bag and the inflation is made as ordinarily done. When the effusion is very great, the membrane bulging greatly, or when, after a week's consistent use of the air-douche, there is no improvement, it may become necessary to evacuate the tympanum by opening the membrana tympani from the auditory canal. Under these circumstances, as we are seeking merely to evacuate a catarrhal exudate, and desire to gain primary union of the incised membrane, great aseptic caution should be exercised in order to prevent possible infection of the middle-ear cavity. The opening of the membrane under these circumstances is not very painful and hardly requires a general anesthetic. In very excitable patients nitrous oxid gas may be used. The canal should be thoroughly cleansed with 1:8000 bichlorid solution. All instruments and hands should be prepared as when doing an aseptic operation. The incision should be made from just behind the short process, through the posterior quadrant, nearly to the periphery of the membrane at its lowest point. After the incision, one or more gentle inflations should be made through the use of the air-bag. The effused exudate in the canal should be taken up with sterile cotton, either wound around a cotton carrier or introduced into the canal by knee forceps. After the exudation is taken up, the orifice of the meatus should be closed with a piece of sterile cotton. Usually within twenty-four to forty-eight hours the lips of the wound have thoroughly united. Inflation should be continued, after the exudation has been removed in the manner directed above, until recovery is complete. Secondary incision is rarely necessary.

Acute Purulent Otitis Media.—In the acute infectious disease, when great pain is complained of in the ear, with a marked increase of temperature, and inspection reveals a congested membrane, vigorous measures must be at once instituted if the process is to be aborted. Local depletion should be resorted to, if the condition of the patient will permit it, several ounces of blood being withdrawn from in front of the tragus. Hartmann and others have great faith, at this stage, in the use of a 10 per cent. solution of carbolic acid in glycerin, applied to the membrane on a pledget of cotton. The bowels should be well opened and the diet should be light. I do not believe in the administration of opiates in these cases, as it tends to blunt the sensibilities and mask the symptoms. Irrigation of warm, sterile water at a temperature of 100° F. may be resorted to. These irrigations are best carried out by the use of a fountain douche, the bag being elevated at only a sufficient height to give a moderate flow to the current of water. If these remedies do not give marked relief within a few hours, or, if instead, the pain becomes greater and the congestion and bulging of the membrane more marked, the membrane should be thoroughly incised. The incision is extremely painful, but, when quickly done, should not require the use of a general anesthetic. This operation should always be done under good illumination. I find, even in very young children, that if the preparations are quietly made, and the knife held from their observation,

they offer no resistance to the quick and thoroughly expeditious incisions of the parts. Unnecessary comments about an operation, ostentatious preparation, and the sight of a knife are apt to terrorize the younger, if not the older, patients, and render necessary the use of an anesthetic, as much to insure the quietness of the patient as the relief from pain. I have never found it necessary to use an anesthetic, and my younger patients are never conscious of my intention until the knife has nearly completed its work. The abortive incision should start just about the short process of the malleus and posterior to it, the knife being carried parallel to the neck of the malleus and inward, until it has pierced the cellular tissue in the tympanic vault and impinges upon the bony wall. The knife is now turned back to the periphery of the membrane, the incision from the periphery being carried a short distance along the posterior superior canal wall. In making the backward sweep of the knife, if it impinges against the long process of the incus, care should be exercised in allowing it to glide over it; otherwise, there is danger of displacing the ossicle. The knife should be made to incise thoroughly through the soft structure. This little operation should be done with aseptic precaution, as its purpose is not to evacuate fluid, but to aid in aborting the inflammatory process. Free irrigations with sterile water at a temperature of 100° to 110° F. should be resorted to after the procedure to promote hemorrhage and aid in allaying the inflammation. As in most cases following the acute infectious disease, as in scarlet fever, the exudate has already taken place when pain is manifested, we find, on inspection, the membrane already bulging. Abortive efforts, under these circumstances, are more than useless. The incision should, in these cases, be made through the most prominent portion of the bulging membrane, and carried upward to the superior margin of the meatus. Great care should be exercised in making the incision that the whole structure of the membrane should be thoroughly incised through into the tympanic cavity. If a spontaneous rupture has taken place and the opening is not sufficiently large or thorough, a tit-like protrusion in the posterosuperior quadrant of the membrane, it should be extensively enlarged. After artificial or spontaneous opening of the membrane, the canal must be kept as free as possible from the discharge by frequent irrigation of the canal with warm antiseptic solution. Either the boric acid solution or a 1: 10,000 bichlorid solution answers the purpose well. It is also well to keep the orifice of the meatus well greased with a carbolized vaselin, in order to prevent infection of the meatus. The frequent irrigations not only deplete the tissue, but also lessen the pain, and, by cleansing the meatus, lessen the tendency to infection of the canal wall. These irrigations should be carried out as frequently as required—always in proportion to the amount of the discharge. During the first few days they are required as frequently as every two hours, and, as the discharge diminishes, the interval between their use gradually increases. I do not believe in the use of wicks of gauze or other material introduced in the canal for the purpose of draining. We have an open way for drainage, and these agents can be of no value. The irrigations are all that is necessary

in the majority of cases, as the discharge gradually lessens, and, in the course of one to three weeks, ceases entirely, with or without complete repair to the membrana tympani. It is usually wise, after the first week or ten days of irrigation, when the discharge has lessened considerably, to dispense with further frequent irrigations, as they sometimes seem to increase, rather than diminish, the discharge. Under these circumstances it is well for the medical attendant to cleanse the ear once a day, either by irrigation or by the use of mops of absorbent cotton, as the circumstances of the case seem best, and terminate the dressing by dusting over the membrane powdered boric acid or pyoktanin. The pyoktanin should be used 1 part of pyoktanin to 8 of boric acid. The dressing should be repeated daily, until the powder remains dry on the membrane for the period of twenty-four hours. After three or four days the canal may be gently washed out, when the membrane will be found healed. If, after a period of two weeks, the discharge continues quite as profuse as at first, becomes tinged with blood, or there is a recurring pain within the tympanum, it is evident that we have conditions arising which require more active treatment. The profuse discharge is frequently due to the carelessness of patients in regard to cleansing the canal, or to caries or necrosis of the ossicles, tympanic walls, or labyrinth. The occurrence of blood in the discharge is usually an evidence of granulation development along borders of the perforation, or profuse hypertrophy of the tympanic mucosa, which, protruding through the perforation, forms an aural polyp. The recurring pain is due to periostitis; to caries; most frequently to stoppage of the perforation by granulations, giving rise to retention of secretion within the tympanic cavity. When the character of the exudation, as well as examination, shows the discharge to be maintained by caries or necrosis of ossicles, tympanic walls, or labyrinth, they should be treated along ordinary surgical lines, the area of caries cureted, and the sequestrum removed when separation is complete. When we find granulations forming about the edges of perforation, or springing from tympanic mucosa, they should be removed by the ring knife or dull curet. The remainder, after using the above-mentioned instruments, or when the granulations are too small to be engaged by these instruments, are best treated by cauterization with chromic acid. It is always advisable to use a 10 per cent. solution of cocain before resorting to these procedures, as they are quite painful. The chromic acid should be fused on the end of an applicator or probe, and the area to which the escharotic is to be applied should be dried as thoroughly as possible with absorbent cotton. The chromic acid should be applied only to the tissue which it is desired to destroy. When pain is due to retention of secretion as the result of a tit-like perforation, or to a perforation which has a tendency to close before the tympanic cavity has ceased to suppurate, they should be appropriately enlarged. When the result of tympanic periostitis, I find no line of treatment gives such radical relief as syringing warm boric acid solution, 120° F., into the tympanum through an Eustachian catheter introduced into the Eustachian tube. Occasionally, as the result of scarlatinal destruction of the greater por-

tions of the membrane, the mucosa of the exposed tympanum may show a distinct diffuse infiltrated appearance. Under these circumstances we make use of the metallic mineral salts, preferably in aqueous solution. The salts most frequently used are those of nitrate of silver, from 1 to 2 per cent.; the sulphate of zinc, from 2 to 4 per cent.; and the sulphate of copper, 10 to 20 gr. to the ounce. It is well to begin with the weaker solutions, and be governed in their application by the results obtained. These applications should be made daily or on alternate days. Occasionally we find the best results gained by not continually using the same salt, but by changing from one to the other of the mineral salts. After the closing of the perforation has taken place, inflations of the middle ear should be carried out in the same manner as they are employed in acute catarrh of the middle ear. These inflations are resorted to for the purpose of preventing adhesion between the membrane and tympanic wall, to break down adhesion between ossicles, and promote absorption of the products of inflammation, and to aid in the restoration of the middle-ear cavity to the normal. Very frequently, during an attack of acute suppurative otitis, we have spontaneous pain and tenderness on pressure over the mastoid antrum and tip, indicating an intense degree of infection, with marked distention of antrum and congestion of pneumatic cells. In many cases the active changes in the mastoid subside with the establishment of free drainage. When pain and tenderness are manifest, immediate measures should be resorted to to arrest the extension of the infection. Cold applied to the mastoid has given better results, in my hands, than any other form of treatment for combating the condition. The cold may be applied through the agency of Leiter's coil, or, by what is more convenient and ever at hand, an ice-bag. The cold should be used as long as the spontaneous pain is relieved and the tenderness progressively abates, with improvement of all local and general symptoms. I am not inclined to limit the application of ice to any fixed number of hours as long as improvement continues. If there is no showing of improvement, or if the condition becomes worse, I do not hesitate, after forty-eight hours, to advise surgical intervention. Occasionally patients will be met with who cannot bear the cold applications—these individuals bear heat well and improve under its application. The patients should be closely confined to bed, have the bowels well opened, and the diet restricted to fluids. It is very unwise to give narcotics to those affected with mastoiditis, as the opiate masks the symptoms. Patients affected with mastoidal involvement require careful watching, the exercise of diagnostic acumen, and that judgment which is the result of ripe experience, to know always when the period of medical treatment has ended and the surgical stage has been reached. One should not be beguiled into a feeling of therapeutic safety by the abatement of certain symptoms, but rather come to safe judgment through survey of the whole status of the case. The two evidences upon which most reliance can be placed, as to the existence of a mastoid empyema requiring operative intervention, is the persistence of the mastoid tenderness and the sinking of the posterosuperior canal wall.

Marked tenderness, as evidenced by moderate pressure over the mastoid antrum and apophysis, intensified in spite of treatment instituted, with sleep-robbing spontaneous pain at night in conjunction with a sinking of the posterosuperior canal wall, are symptoms which should cause an immediate resort to the operative relief of the individual affected. A persistent high temperature, with marked tenderness and spontaneous pain, with a profuse purulent discharge, is also an indication for surgical intervention. Continuous pain, with a temperature ranging about 99° F., with infiltration or edema over the mastoid, is an indication for surgical intervention. Continuous, localized pain, with tenderness on pressure, with a normal or subnormal temperature, and a slow pulse, is also an indication for operative consideration. The great point to be remembered in connection with symptoms pointing to an empyema of the mastoid is that the operation in itself, free of complications, in skilful hands, is in no sense an operation that endangers the life of the patient; whereas, the prolonged retention of pus within the mastoid cells, in close contiguity to so many important structures, is a great menace to the life and welfare of the patient; therefore, long delay, when in reasonable doubt, is not permissible. In considering the details of the mastoid operation, it is reasonable to suppose that one should be prepared to meet all the requirements of antiseptic surgery. No one should attempt the mastoid operation, except under emergencies incident to country practice, without a thorough preparation. The preparation consists of a most thorough knowledge of the anatomy, gained by the careful study of dry and wet preparations, and the frequent doing of the operation on the cadaver.

In men, I always insist upon a thorough shaving of the whole head; in women, a shaving of the whole head, or for an area of at least 2 inches around the seat of operation, the remainder of the hair to be enclosed in a rubber hair bag, or whatever form of dressing that will best retain the hair.

The more complete the armamentarium, the better and more rapidly can the operation be done, and the more prepared is one to meet the various conditions that may arise. The operative field should be as thoroughly prepared as in doing general aseptic surgery. The canal should be cleansed with 1:2000 bichlorid solution, and the canal then stoppered with iodoform or sterile gauze. All preliminary preparations of the operative field should be made before the anesthetic is given, a wet bichlorid dressing, retained by a bandage, being applied over the entire operative field, and allowed to remain until the patient is placed upon the operating table. At times the tenderness over the mastoid will be so great as to prevent the preparation of the operative field until after the patient is anesthetized. A wet bichlorid towel should be placed around the head and a sand-bag under it. The surgeons and assistants prepare themselves, and the instruments should be prepared according to modern surgical methods. The primary incision should be made from a point corresponding to the upper attachment of the auricle directed downward, close to the line of the

insertion of the auricle, until it reaches the lower portion of the auricle, when the incision is continued directly downward, terminating over the middle of the insertion of the sternocleidomastoid muscle, about ½ inch below the tip of the mastoid process. The incision should be made through all of the soft tissues, including the periosteum. I usually hug the insertion of the auricle in this primary incision quite closely. Care should be exercised in not dividing the temporal muscles in the upper extremity of the incision, as it gives rise to annoying oozing of blood throughout the operation. All bleeding points should now be controlled. The periosteum should now be elevated and a wide, bony field exposed. The canal, its posterior wall, the meatal spine, and the linea temporalis should be well brought into view. The mastoid tip should be also freed, so that the fingers can well encircle the exposed tip. The cutting away of the tendinous fibers of the muscle around the tip can be best accomplished through the use of dull pointed scissors, curved on the flat. After the periosteum has been well elevated, anteriorly and posteriorly, and all bleeding checked, the two flaps of soft tissue should be held asunder by the use of automatic retractors. The exposed mastoid should now be examined for a fistulous tract. Should a fistulous tract exist, this may be taken as a guide to our entrance; otherwise, the antrum is entered by chiseling away the bone in the suprameatal triangle of McEwen. A safe and sure guide is never to go above the superior canal wall, and to hug very closely the posterior canal wall. The linea temporalis, when well marked, forms a safe guide for the superior limit of the bone wound. A groove 1 to 1½ inches in length, the anterior portion of which skirts closely the posterior canal wall, should be gradually deepened by successive shaving away of the bone, working from above downward and inward, at first with the flat, and later with the grooved chisel, until the mastoid antrum is entered. The entrance of the antrum is indicated by opening up a more or less roomy cavity, through which a curved probe glides forward, downward, and inward for a distance of about ¾ inch, at which point it enters the middle ear cavity. Ofttimes the removal of the cortex exposes a large cavity filled with pus and granulation tissue, the antrum and pneumatic cells, through destruction being thrown into one large cavity; at other times we have to pursue the chiseling for ½ inch in depth before reaching the antrum. When a larger cavity is exposed after removing the first shaving of bone, it is well to remove the cortex over an area sufficiently great to permit the easy introduction of the fingers in order to explore the cavity before any extensive evisceration of bone is attempted or curets are used on the walls of the cavity. If this precaution is taken, the exposed sinus and dura will occasionally be revealed and thus saved from injury. All diseased bone should be now removed with chisel, spoons, or rongeurs, as the exigencies of the case may demand. The passage between the antrum and the tympanum should be cureted with a narrow spoon. The auditus is always filled with granulation tissue and its walls are frequently carious. The large cells at the apex of the mastoid should be exposed, and, if found diseased, the whole tip must be removed. It is

necessary to pursue the removal of bone until sound bone is encountered in every direction. Often, in making a primary incision, it is well to enlarge the wound through soft tissues by making a horizontal incision backward, from the middle of the vertical incision, of sufficient length to give free exposure and abundant room for unhampered work. If the internal table be affected, it should be removed as freely as the outer table or cells until healthy bone is also here reached. Exposure of the sinus and dura should give no cause for anxiety, and should, with careful work, be unattended with injury to either. After the limit of diseased bone has been reached in every direction, the rough edges of bone should be smoothed and the cavity dried with sterile gauze. If the sinus or dura be exposed, this should be packed off with separate strips of iodoform gauze. The cavity is then packed with iodoform gauze, the strip being first introduced into the auditus and the cavity then filled in. If a posterior incision be made, this should be brought together with silkworm gut. I do not believe that any good is accomplished by reducing the size of the vertical incision through the use of suturing. Several layers of sterile gauze and absorbent cotton are then applied over the wound and a bandage applied for retention. The wound is not dressed until after four days, unless a high temperature (above 101° F.) persists or local pain indicates that it requires investigation. The after-dressing should be made every day or every second day, according to circumstances.

After the operation has been thoroughly completed instead of using the gauze packing the blood-clot method may be resorted to. By this method the eviscerated bony cavity is permitted to fill up with blood and then the soft tissues are sutured and the ordinary external dressing is applied.

By this method primary union is sought, thus lessening greatly the period of convalescence.

In limiting acute inflammation of the labyrinth, very little can be done in the panotitides, as the changes in the labyrinth occur simultaneously with the pathologic changes in the middle ear, even, at times, antedating them. Where these changes are secondary to severe acute suppuration, active and timely measures, directed to the limiting of the middle-ear suppuration, are effective, not only in preventing but also in limiting, the destructive changes in the labyrinth. After the labyrinth is infected the subsequent treatment depends upon the character of the pathologic changes produced. In simple inflammation, frequent irrigation of the ear for the purpose of cleanliness is essential. After the subsidence of the acute symptoms, it is advisable to administer the muriate of pilocarpin in small doses, hypodermically or by the mouth. In those cases resulting in caries or necrosis, the condition is to be met along the ordinary surgical lines. In a great many of the infectious diseases we have as a complication a change in the labyrinth, which is characterized by more or less sudden impairment of the hearing, tinnitus, giddiness, with sometimes frontal or occipital headache and vomiting. This change is frequently due to a congestion of the labyrinth, with more

or less disorganization of the terminal apparatus of the auditory nerve, and is frequently due to an effusion of fluid into the labyrinthine cavity. The treatment for this condition has for its object the reduction of labyrinthine pressure and the absorption of the exudate. The one therapeutic agent which seems capable of accomplishing this purpose is pilocarpin, administered in small doses. Later, strychnin, in fairly large doses, is indicated to stimulate the nerve and lessen the depressing action of the pilocarpin.

THE SURGICAL TREATMENT OF THE JOINT COMPLICATIONS OF THE INFECTIOUS DISEASES

By Joel E. Goldthwait, M. D.

The lesions of the bones and joints which are met in connection with, and which can be considered in any way due to, the various commonly designated infectious diseases are easily understood when it is realized that such bone and joint lesions are due to bacteriologic elements, and are themselves infectious if the term is broadly considered. In practically all of the "infectious diseases" at times lesions of the bones or joints are met with, and while such occurrences are not common—in fact, if considered numerically, are rare—nevertheless they occur with sufficient frequency to make their consideration here proper.

It seems probable that the same infectious element which causes the various characteristic lesions of these infectious diseases may, under certain conditions, invade a bone or joint, or if the specific organism is circulating in the blood, so that all of the tissues are exposed to the infection, it may for some reason become locally active. Just what makes such conditions possible is not always plain, but susceptibility as the result of previous local weakness or disease, or disturbances of the usual circulatory or nutritional conditions, resulting from the injury or exposure, are undoubtedly of some importance. It is, however, impossible many times to offer any very positive opinion, but in some of the cases it seems as though a considerable number of organisms must suddenly have found lodgment in the affected part, as if possibly an infected embolus or a group of organisms had suddenly reached a vessel too small for it to pass through. The disturbance of circulation which would result from this would naturally produce conditions most favorable for the development of the organism, and in some of the cases, especially the suddenly developing osteomyelitis, it seems as if such must be the explanation. It is natural to expect that with the lowered vitality which would be the result of these diseases the resistance of the individual to the infectious element would be lessened, but why at times one part is especially selected or why at times not one part but many parts, as, for instance, the involvement of many joints, is not always easy of scientific explanation. Certain it is that at times the bone or joint manifestation may be confined definitely to one bone or one joint, while at other times many or all of the joints may be involved, or there may be more than one focus of disease in the bone. The degree

of virulence also varies. At times the lesion develops suddenly and is of great virulence, with much destruction of tissue in a short time; at other times the local lesion is slight and scarcely thought of except as a "twinge of rheumatism." With this also it is, of course, impossible to state definite reasons for such variation, except special virulence of the organism or lessened resistance of the individual.

As to the special infections which may be operative in such conditions, it seems probable that the specific organism of the primary disease may at times cause the local lesion, and in certain of the diseases, notably typhoid fever and pneumonia, this has been shown to be true by the detection of the organism in the local lesion. With a better understanding of the etiologic factors of the other infectious diseases it seems probable that this same local specificity will at times be shown.

It is also probable that in many of the cases the infectious disease simply serves to lower the vitality of the individual, so that with the lessened resistance, other organisms which are present in the body and which under ordinary conditions may be beneficial, or at least not harmful, under these changed conditions may assume proportions of definite seriousness. Some of the cases of more or less general rheumatism, or infectious arthritis, starting at these times, and which from their behavior are in every way similar to the many cases which commonly develop without the coincidence of the general infectious disease, are probably in no sense specific of the infectious disease, but have developed because the common organism in the throat, intestines, or elsewhere have not been properly "policed" at the time when the general resources were engaged in fighting the general disease.

The same thing is true of the cases of osteomyelitis, undoubtedly due to the staphylococcus or the streptococcus, in which in all probability these organisms were not the cause of the primary diseases, but were able to gain lodgment locally as the result of lessened resistance consequent upon this general disease.

TREATMENT

The treatment of such conditions must naturally depend upon the special features in the individual case. If the local lesion is probably the result of the specific poison of the general disease, there is little to be done for the local manifestation other than to protect the joint by splints or dressings, unless there should be definite evidence of suppuration. If this occurs, drainage of the abscess is indicated, and with the evacuation of such an abscess there is often a marked general improvement immediately following. This rapid improvement is similar to that often seen in tuberculous lesions where the removal of an active focus in one part of the body is often followed by improvement generally as well as in the foci present in other parts. Apparently the removal of such an active focus relieves the system of part of the struggle it is making to suppress the disease, so that all the energy which had been scattered can thus be directed to the control of a much more limited area. This

rapid improvement is particularly striking if the local process is due to the pneumococcus.

In draining such abscesses it is desirable to open just as little uninfected tissue as possible, since the resistance of the individual is so slight that the absorption from freshly incised tissue occurs with great ease. For this reason if delay is not dangerous it is well to wait until the abscess is fairly near the surface before incising. It is also well not to curet or otherwise disturb the inside of the cavity, since by so doing the granulations are damaged, making absorption from these fresh surfaces easily possible. To still further lessen the chances of absorption the edges of the wound and all of the freshly incised tissue should be wiped with alcohol or the tincture of iodin. No attempt should be made to close the abscess wound, since unobstructed drainage, allowing the rapid discharge of the purulent material, is in every way to be desired. If the incision through the fresh tissue is at all deep, a loosely inserted seton or wick should be used to prevent the edges of the wound from joining. The abscess should be allowed to granulate or close at any time when it is evident from the patient's general condition that the natural resistance is fully equal to the control of any of the infected tissue which may not have been discharged. As a matter of fact such local processes are usually acute in their development and are rapidly healed, so that rarely more than a few weeks is required before the local process is fully controlled.

The result of such a local inflammation naturally depends upon how destructive the disease has been. This may be slight, so that there is but little to show for it, with practically no impairment of function. On the other hand, the destruction may have been great, so that the joint is seriously damaged or so that considerable portions of the bone may have been destroyed. Between these two extremes there are all possible variations, and the after-treatment, once the infection is controlled, will depend upon these factors.

If the local process develop in the bone the virulence may be so great that a considerable portion of the bone is destroyed, with an onset so abrupt that the local necrosis is established before any warning occurs. In one instance that has come under the writer's observation the entire shaft of a tibia was suddenly destroyed in connection with an attack of measles, the osseous lesion being a fulminating case of osteomyelitis, due undoubtedly to an embolus suddenly shutting off the blood-supply to the bone and at the same time infecting the tissue beyond. In such a case there is naturally nothing to be done other than to drain the abscess, which usually develops in a very few days, and wait until the necrosed bone is sufficiently loosened for its removal to be easy. In this, if the patient is a child, the growing elements in the bone should be borne in mind and preserved as much as possible. It should also be remembered that if the epiphyseal cartilage has been damaged so that it is not capable of as efficient bone production as normal, its activity can oftentimes be stimulated by allowing some of the necrosed tissue to remain in comparatively near contact to the cartilage. The presence

of such tissue naturally represents an irritant and must result in stimulation of the local circulation, with greater activity to the adjacent structures. By recognizing such qualities, some of the mutilation which would otherwise be the result of such disease can be avoided. In one instance in the writer's experience, in which the leg as the result of destruction of the tibia was $1\frac{1}{4}$ inches short, a small sequestrum situated just below the upper epiphyseal cartilage was purposely not removed, with the result that within a year the affected leg was $\frac{3}{4}$ inch longer than its fellow. With the removal of the sequestrum at that time the growth became so much retarded that within two years the leg was nearly $\frac{3}{4}$ inch short. In this case it would have been better had the sequestrum been allowed to remain for a somewhat longer time, so that the ultimate length of the legs would have been more nearly the same.

In case the process in the bone is not so extensive and results in the more common condition designated as furunculosis of bone, the local symptoms are much less acute and the true nature of the condition is often not appreciated. Continued aching pain, with slight swelling about the ends of the bones, coming on in connection with an infectious disease should always make one suspicious and lead to a thorough examination, in which the radiograph is oftentimes absolutely necessary. With this the small cavity or cavities can almost always be detected, after which drainage becomes a simple matter, with usually rapid recovery.

If the joint be the part affected and if the infection is of the severe or destructive type, there is little to be done at first other than to make drainage of the affected part and by irrigation effect the removal of the destroyed or infected material in so far as is possible. With such drainage there is usually rapid subsidence of the local inflammation, and with protection of the part by splints to limit the joint motion local healing takes place. After the special infection has passed and the part is firmly cicatrized, the restoration of the joint to as nearly as possible its normal function must be most carefully considered, with the institution of whatever procedures may contribute to this.

If, however, the joint disease goes on without suppuration, manifesting itself as swelling and sensitiveness in one or more joints, the condition is similar to that more commonly designated as rheumatism, and represents an infectious arthritis, the local symptoms being due either to a toxemia or to the presence locally either of organisms nonsuppurative in character or of a low degree of virulence. The treatment of such a condition is similar to that which would be indicated for this form of rheumatism. The part should be protected so that painful use is prevented, care being taken to see that the positions assumed in the painful stage are not such that in case the joint should become stiffened in this position it would lead to an unnecessarily great impairment of the function of the part. After the swelling and sensitiveness have subsided, motion should be undertaken as soon as possible, so that functional limitation will be the

least possible. To facilitate this, massage, baking, stimulating bathing, etc., have their place.

In all such conditions in the control of the local disease naturally every detail of hygiene that will increase the individual's resistance to an infectious disease should be observed, and in this connection, since many of the organisms which may be absorbed and become active in the joints develop in the throat and in the intestines, special care should be taken to see that these parts are thoroughly cleansed by gargles, cathartics, or irrigation.

ANIMAL PARASITES

By David Riesman, M.D.

Of the metazoan parasites infesting man, those living in the intestinal canal are clinically the most important. They may be present singly or in large numbers, and may or may not give rise to symptoms. Formerly the disturbances produced by worms were attributed to obscure reflex influences; in a large degree, however, they are dependent upon direct mechanical irritation. This, at least, is true of pain, diarrhea, inflammation of the appendix, and obstruction of the biliary and vascular channels.

Another factor in the symptomatology is loss of blood caused by those worms that are blood-suckers. Some of the latter secrete an anticoagulin which, like hirudin or leech-extract, causes persistence of bleeding.

A number of parasites seem to produce profound disturbances, chiefly of the blood, through the agency of toxic substances either secreted by them or set free in the disintegration of their tissues. Finally, parasites may, by causing lesions of the mucosa, make a pathway for the entrance of pathogenic micro-organisms.[1]

Three principal factors favor helminthiasis—lack of cleanliness, consumption of raw animal food and contaminated drinking-water, and an intimate contact with lower animals. The prophylactic measures that the mere mention of these factors suggests will be more fully discussed under the different species of parasites.

Active treatment for intestinal worms should never be undertaken unless there is proof that the individual is infested. The laity often assume that a child has worms because it is languid, poorly nourished, has itching of the nose or anus, or is restless at night and cries in its sleep. Only when observation has shown the presence of links or of individual worms, or when the microscope has revealed the presence of ova in the stools, is the institution of anthelmintic measures warranted. It is the physician's duty in all cases in which the existence of worms is suspected or is possible to examine the feces himself for parasites or eggs. Even when the statement is made that worms have been passed, it is advisable, before beginning treatment, to have a specimen brought to the physician, inasmuch as neurasthenic patients often mistake shreds of mucus or of connective tissue or vegetable fibers for parasites.

If one examination has been negative, a brisk purge may be given, such as castor oil, or a small dose of a vermifuge, *e. g.*, five minims of

[1] Guiart, Arch. de parasitol., xi, 175.

the oleoresin of aspidium. The examination for ova is extremely simple. A little of the stool is spread on a glass slide, mixed with a drop of water, covered with a cover-glass, and examined with a $\frac{2}{3}$ or $\frac{1}{5}$ objective. The ova are so conspicuously different from everything else found in the feces that a diagnosis of parasitism can, as a rule, be made at a glance.

Should the usual method of examination fail, that described by Telemann[1] may be employed: from five places of the feces pea-sized portions of material are taken and triturated in a test-tube with hydrochloric acid and ether, equal parts. The mixture is filtered through a hair-sieve and the filtrate centrifuged. The sediment is examined in the ordinary way under the microscope.[2]

If ova are not present, but if Charcot-Leyden crystals are found in abundance, the suspicion that tapeworm exists is justified. The naked-eye examination of the bowel movements should not be neglected; usually, however, the microscopic is more important and informing. For animal parasites other than those of the intestinal canal, urine, sputum, blood, and tissues must be examined according to the suspected site of infestation. The methods of examination will be discussed under their proper headings.

Persons known to be harborers of intestinal worms should be urged to disinfect their feces. The number of ova discharged with a single bowel movement is in some cases enormous, and when it is realized that each ovum is capable in a suitable host of developing into a parasite, the propriety of this form of prophylaxis becomes apparent. The use of latrines and closets and modern methods of sewage disposal are also prophylactic measures of great value.

It might not be unwise to incorporate in text-books of physiology for schools a few lines explaining the sources of worms and the ways of guarding against infection.

Tapeworms. Cestodes. Tæniasis

The tapeworms, which belong to the zoölogic class Plathelminthes, require two hosts to round out their life cycle. For most of those infesting him, man is the definitive host in whom the worm reaches its highest or adult development. In only one important instance, that of the Tænia echinococcus, is man the intermediate host, the adult worm living in the dog.

The diagnosis of tapeworm is usually made by the patient himself by finding the links in the stools or in the bed-clothing, after they have crawled out of the anus at night. On microscopic examination the characteristic ova are readily detected in the stools. Since some species of tapeworm, especially dibothriocephalus, may cause profound anemia, physicians should make it a practice to examine for ova bowel movements of all cases of obscure blood dyscrasia.

[1] Deut. med. Woch., 1903, No. 35.
[2] See also Quadflieg, ibid., 1909, No. 48.

PROPHYLAXIS

Tænia saginata.—Synonym, Tænia mediocanellata. Infestation with Tænia saginata, the common tapeworm, occurs from eating beef containing the cysticercus or measle of the tapeworm, the tongue and muscles of mastication of cattle being the parts most often invaded. Prophylaxis is achieved by rigid meat inspection and condemnation of all infested meat. Through this measure much has been accomplished, but, as it is not always perfectly applied, there is still danger in eating raw or very rare meat. The cooking of meat destroys entirely its infectivity. In making beef-juice by expression, where raw or slightly broiled meat is used, the juice should be strained through a very fine-meshed fabric, such as a handkerchief.

Tænia solium, or pork tapeworm, is exceedingly rare in the United States, due largely to the well-organized meat inspection in abattoirs. Nevertheless, it is a wise precaution to abstain from eating raw pork or bacon which may contain the measle of the tapeworm.

Dibothriocephalus latus.—Synonym, Bothriocephalus latus. Dibothriocephalus disease, which seems to be on the increase in this country, is brought about by eating raw, smoked, or imperfectly cooked fish, especially salmon, pike, turbot, and other fresh-water fish containing the larvæ of Dibothriocephalus latus. The serious nature of fish tapeworm infestation makes it important from the standpoint of general prophylaxis to find out the worm-bearers and to expel and destroy the parasites. In that way contamination of the water in our lakes and streams may be prevented. It is self-evident that only thoroughly cooked fish should be eaten.

Tænia echinococcus, as already mentioned, reaches its adult stage in the dog, the scolex occurring in man and herbivorous animals in the form of the hydatid cyst. Prophylaxis demands the destruction of infested meat in order to prevent dogs from eating it, and care in the handling of dogs. Dogs should not be allowed in abattoirs. The disease is fortunately not common in the United States; it occurs usually, but not always, in foreign-born persons—in those coming from countries where the association of man and dog is intimate and habits of cleanliness are yet to be acquired.

Hymenolepis nana.—Synonyms, Tænia murina; Tænia nana. Infestation with the dwarf tapeworm is fairly common,[1] and is brought about through the contamination of food with droppings from rats and mice. This fact adds another to the many arguments for the energetic destruction of these rodents. As there is a possibility of direct contagion from man to man,[2] personal cleanliness and a certain degree of isolation of infested individuals is advisable.

Dipylidium caninum.—Synonyms, Tænia canina, Tænia cucumerina, and Dipylidium cucumerinum.—Dipylidium caninum is a

[1] Deaderick, International Clinics, iv, nineteenth series, 252; Stiles, New York Med. Jour., 1903, lxxviii, 877; Schloss, The American Journal of the Medical Sciences, May, 1910, 675.

[2] Deaderick, loc. cit.

tapeworm of dogs and cats, the intermediate stage of which is passed in the dog flea (Ctenocephalus canis) and the human flea (Pulex irritans). It is fairly common in children, Blanchard[1] having collected 60 cases of human infection. Children infect themselves either through caressing dogs and cats, and thereby introducing the fleas containing the cysticercus, or through the medium of food into which insects have dropped. The prophylaxis consists in care in handling dogs and cats and in seeing that these animals are clean.[2]

A number of other tapeworms are known to occur occasionally in man, but they possess as yet more of scientific than practical interest.

TREATMENT OF TÆNIASIS

Preparatory Treatment.—The purpose of preparatory treatment is to render the alimentary canal as empty as possible, so that the anthelmintic remedy may act in strongest concentration upon the worm. Therefore, the patient should eat in moderation the day before. I allow him to take his usual breakfast, at noon a cup of broth and a slice of toast, and for the evening meal a glass of milk or beef-tea. The German custom of giving herring, pickles, cole-slaw, or other pungent articles the evening before has never become popular in this country. On going to bed the patient takes a brisk purge, either castor-oil, f℥ss to f℥j (15–30 grams), or epsom salts, ℥ss to ℥j (15–30 grams).

Throughout the subsequent treatment the patient should be in bed, and, when the circumstances permit it, should have a trained nurse for the day. It is a good plan for the physician to write out the details of the treatment, as success hinges on strict adherence to instructions.

I usually do not allow any breakfast to be given, the patient taking the anthelmintic on an empty stomach. Some authorities, however, permit a cup of coffee or a glass of milk.

The Anthelmintic.—The best remedy for the ordinary tapeworm is aspidium of the U. S. Pharmacopeia, which is the rhizome of Dryopteris filix-mas or male-fern. It is used in this country chiefly in the form of the official oleoresin (Oleoresina aspidii), the corresponding preparation of the British Pharmacopeia being the Extractum filicis liquidum. The average dose of the oleoresin and of the liquid extract as well is 1 dram (4), given in two capsules of ½ dram (2) each. In a vigorous adult the dose of the oleoresin may be larger—from 1½ to 2 drams (6 to 8), given in divided doses in rapid succession.

As a substitute for the oleoresin or extract of aspidium there has lately been placed upon the market a proprietary substance, the supposed active principle of filix-mas, called filmaron, which is given dissolved in nine parts of castor oil, in doses of from 8.5 to 10.0 c.c. of the solution, or dissolved in almond oil in capsules.

In overdoses filix-mas may produce toxic symptoms, and it is a wise

[1] Arch. de parasitol, xi, 1906, 1907, 439.

[2] Blanchard quaintly says: "'Cave canem' écrivaient les Romains à la porte de leurs habitations. Cette formule lapidaire, deviée de son sens antique, résume pour nous un utile précepte d'hygiène."

rule never to exceed the dose of 2½ drams (10); nor should the dose be repeated on successive days. The symptoms which may follow an overdose are vomiting, diarrhea, collapse, transient or permanent blindness, jaundice, stupor, convulsions, and in rare instances tetany. It is probable that the severe symptoms that have been described occur chiefly in such patients as are suffering from profound anemia or some other serious affection.

The treatment of filix-mas poisoning consists in giving brandy or aromatic spirits of ammonia by the mouth, or, preferably, so as not to interfere with the contents of the intestines, strychnin hypodermically.[1]

Expulsion.—The remedies employed against the common tapeworm are of such a nature that they stupefy but do not expel the worm. The expulsion must be accomplished through a purgative agent. The question of the proper purgative is important, as is also that of the time at which it is given. When filix-mas is employed, castor oil should not be used as the expellant, since it renders soluble the toxic principle of the drug, absorption of which may give rise to grave disturbances. Some writers, such as Lenhartz[2] and Matthes,[3] deride this idea, but I believe it is wise to follow the rule here given. Calomel, in 5- or 10-grain dose (0.3 to 0.7), or a bottle of magnesium citrate, or both, may be used. Whatever purgative is chosen, its administration should not be delayed beyond two hours, as otherwise the danger of absorption of the anthelmintic is increased, nor should the purgative be given too soon, as it might sweep out the remedy before it had time to act upon the worm. The best interval is from one to two hours.

The bowels begin to move in from two and a half to three hours after the anthelmintic has been given. This part of the treatment should be carefully supervised. A commode is used, or in feeble individuals or those much affected by the treatment, a bed-pan. It is desirable to have the worm expelled intact, and to this end a piece of gauze is laid over the vessel, which is partly filled with water in such a way that the worm will float upon the water. By this means breakage is usually prevented. At times it happens that the bowels cease moving before the expulsion is completed, leaving part of the unbroken worm in the rectum. In such a contingency a small enema of warm salt water will usually bring away the remainder. Traction on the worm should never be made. The tapeworm, or its parts if it be broken, should be placed with great care into a large jar containing 70 per cent. alcohol and brought to the physician for examination. Naturally, the most important point to determine is whether the head has come away. The neck is so slender and fragile that it not rarely breaks and the head is left behind. In that case the worm may redevelop. This takes from two to three months, *i. e.*, after that time ripe links (proglottides) begin to reappear in the stools.

[1] References to poisoning by filix-mas: (1) Silver-Huguenin, Corresp. f. schweiz. Aerzte, 1898, No. 17; (2) Lépine, Sem. méd., 1891, 327; (3) Ide, Traité de Thérapeutique, 1905; (4) Katayama and Okamoto, Vierteljahrsschrift f. gerichtl. Med., 1894, Suppl.; (5) Schmiedeberg, Pharmakologie, p. 365; (6) Grawitz, Berl. klin. Woch., 1894, No. 52.

[2] Penzoldt u. Stintzing, Handbuch der gesammten Therapie, ii, 583.

[3] Handb. d. inn. Med., v. Mering, p. 492.

Although the head may not be found, it does not follow that it has not been discharged or, at least, dislodged. It is so tiny that it may escape observation, or it may be expelled with a subsequent bowel movement. I have seen cases in which the most careful search failed to reveal the head, in which there was, nevertheless, no recurrence of the disease. The larger tapeworms usually occur singly, but in rare instances several are found in the same host.

Causes of failure:

(1) Inadequate preparatory treatment.
(2) Insufficient dose of the anthelmintic.
(3) Inertness of the remedy.
(4) The presence of mucus in the intestine protecting the worm's head. Ringer advises the administration of ammonium chlorid in large doses to liquefy the intestinal mucus.
(5) It is conceivable that failure may be due to the head being protected by folds of the valvulæ conniventes.

Tapeworm in Children.—The oleoresin of aspidium is the best remedy, and, according to age, is given in doses of from 15 to 60 grains (1 to 4), either divided into small capsules or in an electuary with honey. The preparatory treatment is the same as in adults. For the postanthelmintic purge magnesium citrate, on account of its pleasant taste, is to be preferred. The following formula, suggested by Comby, in which the dose of filix-mas is rather larger than that given above, has been widely used: Ethereal extract of filix-mas, 6; essence of turpentine, 1; syrup of orange-flowers, 30; peppermint water, 50.

In the case of the dwarf tapeworm, Hymenolepis nana, which is comparatively frequent in children, from ½ to 1 dram (2 to 4) of aspidium is the proper dose. It is divided into from three to five doses, administered at half-hour intervals. One-half hour after the last dose magnesium citrate is given.

Contraindications.—The treatment against tapeworm is a decided shock to the system and should not be lightly undertaken. The following are contraindications: Acute inflammation of the gastrointestinal tract, convalescence from typhoid fever or abdominal operations, operation for cataract, grave cardiac or renal disease, pregnancy and puerperium, recent apoplexy, cachectic states, and tendency to hemoptysis. No harm usually results from delaying treatment in case of Tænia saginata; Tænia solium and Dibothriocephalus latus should, however, be expelled as soon as possible.

Other Teniafuges.—*Pomegranate* (Granatum, U. S. P.) is the bark of the stem and root of Punica granatum. Official are the bark, in doses of 30 grains (2), and the fluidextract, dose, 30 minims (2 c.c.). It may be given as a decoction, made by adding 2 ounces of the bark to a pint of boiling water and boiling down to 12 ounces. The preparation is quite efficient, but untoward effects are common, such as nausea, vomiting, vertigo, cramps, and dimness of vision.

Pelletierin is the alkaloid of pomegranate. It is used in the form of the tannate, which in reality is a mixture of four alkaloids. The dose is

not accurately determined, different writers stating it as from 4 to 24 grains. I have given as much as 12 grains to a boy of fourteen without harmful effects. The pelletierin of Tanret is a syrupy liquid sold in vials containing a single dose. Pelletierin should be followed in from one to two hours by a purgative.

Pumpkin Seed.—Pepo, the seed of Cucurbita pepo, is given in doses of from 1 to 2 ounces of the seeds in an unstrained emulsion of sugar and water or beaten up with egg.

Kamala, the glandular hairs of the fruits of Rottlera tinctoria, occurs in commerce as a red powder which on account of its tastelessness is often given to children, but is probably the weakest of the teniafuges. The dose is from ½ to 3 drams (2 to 12) in mucilage or sugar. The drug is no longer official.

Kousso is used but little in this country, although I have found it of value, and have at times combined it with filix-mas. Henoch considers it the best tapeworm remedy in children. The dose in children is from 2 to 2½ drams (8 to 10), given in two portions, a half-hour apart, in coffee or milk, and followed an hour later by a tablespoonful of castor oil.

Benzene.—Hemmeter has had good results with benzene. The patients received ½ ounce of castor oil and an enema of 1 quart of warm water containing 15 grains of benzene. Three hours later the following mixture was given:

Benzene, c. p.	6 gm. (℥iss);
Mucilage of acacia,	
Licorice syrup āā	30 gm. (about ℥j);
Peppermint water	120 c.c.

One tablespoonful every hour.

Aspidium Spinulosum.—Polystichum spinulosum has been found useful in the treatment of Dibothriocephalus latus.[1] The dose is 1 dram (4) of the extract, followed in two hours by a purgative.

The seeds of *Labœ Merrah*, a plant of Dutch East India, have recently been used with success against tapeworm.[2] The seeds, to about the number of 500, are peeled and taken fasting without other precaution. If the worm does not appear in ten hours, two tablespoonfuls of castor oil are given.

Chloroform, turpentine, oil of eucalyptus, and a number of other drugs have been used in former days for tapeworm. They have been abandoned.[3]

Summary of Treatment of Tapeworm.—(1) Light lunch—cup of broth and piece of toast. (2) At 6 P. M. glass of milk or cup of bouillon. (3) One ounce (30) of castor oil or of magnesium sulphate at bed-time. (4) On awakening, four to six 15- or two to three 30-minim capsules of

[1] Lauren, Arch. f. exp. Path. und Pharmak., 1898, 246.

[2] J. Grim, Tijdschrift voor Geneeskunde, ii, 1909.

[3] It may not be without interest to state that among the Anglo-Saxons there existed a charm composed of a jingle of words without any meaning—gonomil, orgomil, marbumil, etc.—which was to be sung in the right ear of a man, but in the left ear of a woman, in case he or she had swallowed a worm in drinking-water. (J. F. Payne, Lancet, 1903, ii, 6.)

oleoresin of aspidium at fifteen-minute intervals. In a vigorous adult, 2 drams (8) of the oleoresin. (5) In an hour and a half a 5- or 10-grain powder of calomel, followed, if there is no movement in an hour, by a half bottle of magnesium citrate. (6) Receive worm in warm water. (7) If expulsion is delayed, give salt-water enema.

After the expulsion of the tapeworm it is often necessary to improve the patient's general health by the administration of tonics and of digestants containing hydrochloric acid. If there is marked anemia, as there may be in dibothriocephalus infection, iron and arsenic should be given over an extended period.

GENERAL TÆNIASIS

Cysticercosis.—Cysticercus disease in man is brought about by the ingestion of eggs of Tænia solium, rarely of those of Tænia saginata. As a rule, the condition results from autoinfection with eggs by the host of an adult tapeworm; but the infecting ova may be gotten from another tenia-harboring individual. The larvæ developing from the ova are carried to various organs and tissues, the favorite sites being the brain, muscle, spinal canal, heart, vascular system, ocular muscles, and subcutaneous tissue. In these regions the larvæ develop into cysts which may bring about serious symptoms, especially when located in the brain. Sudden death may ensue when the cysticercus occupies the ventricles.[1]

The *diagnosis* is difficult. It may be made by palpating the subcutaneous tissue and discovering the presence of cysts. The possibility of developing a method of serodiagnosis is suggested by Mohr.[2]

Prophylaxis is of the greatest importance. As soon as the existence of Tænia solium is established, the worm should be expelled without delay.

Treatment.—If the cysticercus is superficially located, excision is indicated. Medicinal measures are of no avail when the disease is in the internal organs; fortunately, a fatal ending is rare except in cases of cerebral cysticercosis.

Tænia echinococcus.—The salient features of echinococcus disease and the methods of its prevention have been discussed. (See p. 791.)

The *diagnosis* is difficult. In the case of hydatid disease of the liver it may be made by finding, in addition to enlargement of the organ, the physical signs of an elastic swelling and perhaps the hydatid thrill (Hydatidenschwirren). In the case of pulmonary hydatid disease the characteristic hooklets may be found in the sputum. The history of close association with dogs is suggestive. Eosinophilia is present in a considerable proportion of cases. Recently a method of serodiagnosis based on Gengou-Bordet's complement deflection has been developed.[3]

[1] Schoeppler, Cent. f. allgem. Pathol., 1906, No. 234.

[2] Münch. med. Woch., 1909, lvi, 2552.

[3] References on serodiagnosis of hydatid disease: (1) Kreuter, Münch. med. Woch., 1909, lvi, 1828; (2) Weinberg, Ann. de l'Institut Pasteur, June, 1909; (3) Lippmann, Berl. klin. Woch., 1910, No. 1, p. 13, contains bibliography.

The *treatment* of hydatid disease is surgical if the disease is in an accessible place. Many operations have been devised for hydatid of the liver.[1] Among the French, that of Quénu (formolage) is popular: after laparotomy a 1 per cent. solution of formalin is injected into the cyst; in five minutes the cyst is opened and carefully emptied. It is then sutured and fixed to the abdominal wall.[2] Several German surgeons advocate marsupialization of the cyst. The objections argued against this treatment, the details of which must be looked up in text-books on surgery, are its long duration and the danger of hemorrhage and discharge of bile. Complete extirpation of an hydatid cyst of the liver has been done successfully.[3]

Recently de Renzi[4] has reported success in the treatment of hydatid disease of the liver by the use of filix-mas. He believes that inasmuch as the cyst influences the entire organism, as is demonstrated by the serodiagnostic reaction, the anthelmintic remedy may in turn act upon the cyst through the medium of the blood.

Hydatid rash is an urticarial eruption that sometimes follows tapping or rupture of an hydatid cyst; occasionally it occurs spontaneously. It is accompanied by itching, goose-skin, high temperature, and abdominal pains.

Trematodes (Flukes)

DISTOMIASIS

The trematodes, like the cestodes members of the class of Plathelminthes, are most common in Africa and in the far Orient. They are occasionally found in southern Europe; in the United States most of the cases are imported.[5]

Bilharziosis is a fluke-worm disease, produced by Schistosomum hæmatobium (Distoma hæmatobium). The habitat of the fluke is the portal vein and its radicles and the veins of the bladder and rectum. The chief symptom is hematuria. Infection was formerly believed to be always through drinking-water, but according to Looss[6] the miracidium may enter through the skin. The *diagnosis* is made by finding the characteristic spined ova in the urine and in the stools. The fact that the ova in the feces have a lateral and those in the urine a terminal spine has given rise to much discussion. According to Looss (*loc. cit.*), these two types of ova are merely different stages in the development of the same parasite.

Prophylaxis.—This consists in boiling the drinking-water to guard against oral infection, and in not bathing in water that may be contaminated with the miracidium to avoid infection through the skin.

[1] Colombani, Sixteenth Internat. Congress, Budapest. 1909.

[2] A. Caudoix, Traitement chirurgical actuel des kystes hydatiques du foie et de leurs complications, Paris, 1908.

[3] Nordmann, Zent. f. Chir., 1909, xxxvi, 1217. For thorough review of subject of hydatid disease see Verco and Stirling, Allbutt's System, vol. ii, 1102.

[4] Nuova rivista clin. terap., 1909, xii, 1; Zeit. f. Chir., 1909, xxxvi, 823.

[5] Gunn, Jour. Amer. Med. Assoc., 1906, xlvi, 1031.

[6] Annals of Tropical Medicine and Parasitology, ii, 153.

Treatment.—Drugs seem to have no influence whatever on the hematuria, although various styptics, as well as phenyl salicylate, urotropin, methylene-blue, etc., have been employed. Alcohol and salted or otherwise preserved food of an indigestible nature should be avoided, and red meat should be eaten sparingly. The patient must also guard against chilling, gonorrhea, and other causes of cystitis and enteritis. Instruments must not be passed into the urethra. Improvement sometimes follows change of climate.

When the disease is located in the rectum, suppositories of iodoform or ichthyol are useful.

Schistosomum japonicum.—This fluke-worm, discovered by Katsurada in 1904,[1] and almost simultaneously by Catto,[2] causes an enlargement of the liver and spleen, a morbid hunger, rarely anorexia, diarrhea, which is often bloody and slimy, ascites, and edema. The chief habitat of the parasite is the veins of the mesentery and the portal vein. Its eggs are found in the liver and in the mucosa of the intestine. At times the worm gets into the circulation and is then likely to be arrested in the brain, causing in some instances Jacksonian epilepsy. Yagi[3] has found a hemolytic substance of a lipoid nature in the body of the parasite. The larvæ, according to Katsurada and Hashegawa,[4] enter through the skin and develop within a month to sexual maturity.

Diagnosis.—The diagnosis is made by finding the ova in the stools, or, on the postmortem table, by microscopic examination of scrapings from the diseased bowel.

Prophylaxis.—Katsurada and Hashegawa (*loc. cit.*) recommend that all egg-containing excrement be boiled before it is used as fertilizer. The laborers working in rice fields should wear leggings.

Treatment is unsatisfactory.

Paragonimiasis.—Paragonimiasis or endemic hemoptysis is a disease of China, Japan, and the Philippine Islands, an occasional case being found in the United States. It is due to a trematode worm, Paragonimus westermanni—synonyms, Distoma ringeri, Distoma pulmonale. Very little is known of the life history of the parasite, but it is probable that a small mollusk is the intermediate host. Its chief habitat is the lungs, and the principal symptom, a mild type of hemoptysis. It may, however, enter the circulation and lodge in the brain and eyelids or other parts of the body. Several of the lower animals, such as cats, dogs, tigers, and swine, may harbor the paragonimus.

The *diagnosis* is based on the discovery of eggs in the sputum.

Prophylaxis.—Disinfection of the sputum and destruction of animals known to be infected are important. Boiling the drinking-water and cooking the food, in the absence of any knowledge of the mode of infection, are wise precautions.

The *treatment* of pulmonary paragonimiasis is general and sympto-

[1] Looss, Cent. f. Bakter., Parasit. u. Infektionsk., 1905, xxxix, 280.
[2] Brit. Med. Jour., January 7, 1905.
[3] Arch. f. exper. Pathol. u. Pharmakol., 1910, Heft 2 and 3, 156.
[4] Cent. f. Bakter., Parasit. u. Infektionsk., 1905, liii, 519.

matic. The disease is mild. No method is known by which the parasite can be killed in the lungs. If the disease is localized in the brain, operation may be advisable if the seat can be definitely localized.

Fascioliasis.—This is an infection with the Fasciola hepatica (Distomum hepaticum, liver fluke), which is found in the biliary passages both of man and numerous herbivorous animals. It causes cholangitis and cholecystitis, with swelling and tenderness of the liver and jaundice. In certain localities the parasite infests the mucous membranes of the pharynx and adjacent parts. The intermediate host is a small fresh-water snail, Limnæus minutus or some other species of Limnæus. The disease is exceedingly rare, and while usually mild, may cause great enlargement of the liver, with ascites and jaundice. At times there is a cholangitis with thickening and even calcification of the walls of the bile-ducts.

The *diagnosis* is made by finding the characteristic eggs in the stools.

Prophylaxis.—As the embryos are aquatic, the drinking-water should be boiled. The treatment of the established disease is purely symptomatic.

Fasciolopsis buski (Distomum buski).—This is a trematode parasite common in Asiatics. It is very rare in this country; a case has been reported by Moore and Terrill, Galveston, Texas.

Clonorchis sinensis.—Synonym, Distomum spathulatum. This parasite is found especially in China and Japan, and usually inhabits the biliary passages. The eggs are found in the stools. The mortality is high (14 per cent. of those infested).

Prophylaxis consists in boiling the drinking-water and not eating uncooked fish or mollusks.

Opisthorchis felineus.—Normally, this fluke-worm inhabits the gall-bladder and bile-ducts of the cat, but it has been found quite frequently in man, especially in Russia, Siberia, and East Prussia. It produces dilatation of the bile-ducts and at times jaundice and ascites. Infection probably takes place through the eating of fish.

The *prophylaxis* consists in boiling the drinking water and abstaining from the eating of uncooked fish and mollusks.

NEMATODES (Round-worms)

ASCARIASIS

Ascaris lumbricoides.—This is the common round-worm of the intestine. It is found chiefly in our foreign-born population, among the Italians, Poles, Hungarians, and Austrian Slavs, but occurs also in native Americans. It is frequent in children and may be present singly or in large numbers. No intermediate host is known, the infection taking place through swallowing of the eggs contained in soil or water. It is possible that flies may act as egg-carriers.

The worms may be discharged by the bowel or may crawl out of the mouth or be vomited. Moscucci[1] reports a case of suffocation from an

[1] La Riforma med., xiv, 1898, part 1, 124.

ascaris getting into the trachea. During typhoid fever and other febrile diseases, round-worms, when present, are usually started on their wandering, and may issue by the mouth or the anus.[1]

Appendicitis and obstruction of the biliary passages and of the intestines[2] may at times be produced by round-worms.

The *diagnosis* is easy, as worms are usually passed by the rectum, more rarely by the mouth. In the absence of such *prima facie* evidence the diagnosis is readily made by finding the eggs in the feces.

Prophylaxis.—Children infested with round-worms should be imbued with the importance of cleanliness. They should wash their hands thoroughly after defecation, so as not to contaminate their or other children's food with ova. Stiles[3] considers it possible that flies, by breeding in privies, may act as disseminators of the ascaris.

Treatment.—Santonin, according to all authorities, is the best remedy. The dose for an adult is from 2 to 4 grains (0.13–0.26); for a child, from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.016–0.023). For children the official troches (Trochisci santonini) may be used, each containing a half grain. Santonin is best administered combined with calomel: for a child 1 or 2 grains of calomel to $\frac{1}{3}$ or $\frac{1}{2}$ grain of santonin, three times a day. It may be given again on the following day, and thereafter every three or four days, until worms are no longer expelled or until eggs have disappeared from the feces. As experiments have shown that it takes about one month for the development of the ascaris from the ovum to the sexually mature parasite, the feces should be reëxamined for ova after a month to make sure that the treatment was effective.

Santonin may produce toxic symptoms: yellow vision (xanthopsia), vertigo, cramps, nausea, vomiting, diarrhea, stupor, and paralysis. Treatment consists in lavage and the use of narcotics, especially chloral.

Other Vermifuges.—Wormseed, chenopodium, in doses of 20 to 30 grains (1.3–2.0), or its oil, in doses of 5 to 10 drops, is an efficient remedy.

Spigelia.—This is best given in the form of the Fluidextractum spigeliæ, in doses of 1 fluidram (4 c.c.), generally combined with an equal amount of fluidextract of senna:

Fluidextracti sennæ,	
Fluidextracti spigeliæ	āā 4
Syrupi	q. s. ad 30.

Thymol has also been used in doses of from $7\frac{1}{2}$ to 30 grains (0.5–2.0).

OXYURIASIS

The Oxyuris vermicularis (seat-, pin-, or thread-worm) is a minute worm, very common in children and not rare in adults; in women it is quite frequent. Its presence produces itching of the anus and vulva and may lead to onanism. The normal habitat of the worm is the cecum and appendix, and even the small intestine, and not, as is gener-

[1] Riesman, Proceedings Pathological Society of Philadelphia, 1902–3, vi, 55.
[2] Venning, Jour. Amer. Med. Assoc., June 18, 1910.
[3] Osler's System of Medicine, i, 597.

ally believed, the colon and rectum. After the females have been impregnated they migrate to the lower part of the large bowel and crawl out through the anus, to discharge their millions of ova. Still[1] found oxyuris in the appendix at autopsy in 25 out of 38 cases harboring the worms; in 6 of these the appendix seemed to be the only habitat. This explains why the worms are occasionally found as the cause of appendicitis.[2]

There appears to be no intermediate host, the individual usually infecting himself through lack of cleanliness after defecation, or through the fingers becoming contaminated by scratching the perineal region. If the disease exists in one child in a family, the other children are very apt to become infested. Eggs have been found under the finger-nails of children.

The **diagnosis** is easily made. The worms may be seen on the buttocks or about the anus or crawling on the feces. In the feces the characteristic eggs may be found upon microscopic examination.

Prophylaxis.—Inasmuch as the eggs may be carried from the anus to the mouth by the fingers, washing of the hands and of the buttocks after defecation is important. Even the finger-nails should be cleansed, since, as already mentioned, oxyuris ova have been found in the dirt under the nails of infested children.

Treatment.—Treatment often fails because it is limited to rectal injections. As the worms are not confined to the rectum or lower bowel, and have their normal habitat in the cecum and appendix,[3] they must be attacked from both extremities of the alimentary canal. The best remedy by the mouth is santonin, given in the same doses as are used in ascariasis —$\frac{1}{2}$ grain combined with a grain of calomel, three times a day for three days. Locally, various solutions are employed in the form of enemas. I have always used the infusion of quassia, prepared by soaking 1 ounce of quassia chips in a pint of cold water. After a cleansing enema, from 2 to 4 ounces of the quassia infusion, slightly warmed, are injected. This is repeated once or twice on successive days. Simple salt solution, soap water, or vinegar, f℥ss to f℥j (15–30) to the quart of water, may be used. Unger prefers an injection of liquor ammonii acetatis f℥ss (15 c.c.) to a liter of water. Thymol (1:100 olive oil) and ether (4 to 8:100 water) have also been employed. If the worms reappear, the entire treatment should be repeated twice, with weekly intervals. For the itching a calomel ointment, ℥ss to ℥j (2–4) to ℥j (30) of petrolatum, or one containing menthol, or suppositories of iodoform (5 grains, 0.3) may be used.

TRICHINOSIS

Trichinosis is acquired by eating pork or pork products (ham, sausage, pork-roll) containing the Trichinella spiralis—synonym, Trichina

[1] Common Disorders and Diseases of Childhood, 1909.

[2] T. H. Culhane, Jour. Amer. Med. Assoc., January 1, 1910, 48; see also J. M. Allen, Ibid., July 9, 1910, 127, and A. P. C. Ashhurst, Am. Jour. Med. Sci., October, 1909.

[3] Still, Common Disorders and Diseases of Childhood, 1909, believes that the thread-worms breed in the appendix, a view not shared by most helminthologists.

spiralis. On reaching the intestine, the wall surrounding the parasite is digested and the trichinella escapes. Fertilization takes place before the end of the second day. The gravid females promptly penetrate into the lymph-spaces of the intestines or of the mesentery and deposit their young. The larvæ are carried, chiefly by the lymph-stream, but also by the blood, to the muscles, where they become encysted. The first brood reaches its destination, the muscles, in from nine to ten days. The symptoms are pain, fever, dysphagia, dyspnea, edema, sweating, and eosinophilia. The disease may be mistaken for typhoid fever.

The normal host of the trichinella is the rat.

The **diagnosis** is often suggested by merely thinking of the disease. Small particles of the suspected pork should be examined under the microscope. A high eosinophile leukocytosis has great diagnostic value. Quite recently the trichinellæ have been found in the circulating blood by Stäubli's method.[1] The diagnosis may be made absolute by harpooning a little of the painful muscle and examining it for the trichinellæ under the microscope.

Prophylaxis.—The best preventive is never to eat uncooked pork, ham, sausage, or other articles made from pork. Meat inspection, while theoretically advisable, has not gained the results expected of it. In Germany infected meat may be put to industrial uses, such as the manufacture of glue.

Treatment.—If the infection is recent, lavage of the stomach, irrigation of the bowel, and active purgation are indicated. Calomel, senna, or castor oil may be used. Hemmeter[2] recommends benzine internally and for colonic irrigation. Internally, it is used in a mixture with mucilage of acacia and peppermint water in doses of 10 to 12 grains (0.6–0.75) every two hours. The irrigation, which should be given through a high rectal tube, contains from 4 to 8 grams of benzine to the quart of water. Santonin is also used, in combination with calomel, twice daily. There is apparently no remedy that exerts any influence on the embryos while they are on their way to the muscles. After they have once reached the skeletal musculature, the pains may be relieved by inunctions with hot camphorated oil and hot baths. Profound sweating is treated with atropin and sponging with alcohol. Stimulants are often required.

TRICHIURIASIS

Trichiuriasis is infection with the Trichiuris trichiura (Trichocephalus dispar; Trichocephalus trichiurus), or whip-worm, one of the commonest of intestinal parasites. The cecum and colon are its habitat. It bores directly into the mucous membrane and appears to be a blood-sucker. It is rarely found alone, generally in association with the uncinaria or ascaris, or with both. Symptoms are but seldom produced by it; sometimes there are enteritis, severe anemia, and nervous disturb-

[1] Deut. Arch. f. klin. Med., 1905, lxxxvi, 286; Herrick and Janeway, Arch. Int. Med., 1909, iii, 263; Mercur and Barach, Ibid., 1910, v, 530.

[2] Diseases of the Intestines.

ances. Guiart (*loc. cit.*) believes that, by causing lesions of the mucosa, it is a factor in the production of typhoid fever and occasionally of appendicitis. No intermediate host is known, infection in man taking place by the swallowing of eggs.

The **diagnosis** is made by finding the exceedingly characteristic ova in the stools; the worms themselves are very rarely seen.

Prophylaxis.—The proper disposal of alvine discharges and personal cleanliness are important in prophylaxis.

Treatment.—The removal of the trichiurus is difficult and usually fails. Filix-mas, thymol, and benzine irrigations, 1 dram to 4 drams to the quart of water, have been employed. Unless it can be definitely proved that the worms are causing disturbances, it is best not to persist in attempts at their removal.

UNCINARIASIS

Uncinariasis[1] is one of the most wide-spread of zoöparasitic diseases of man, being found in Asia, Australia, Egypt, and nearly all countries of Europe, in South America, the West Indies, and in the southern part of the United States, especially in Virginia, North Carolina, South Carolina, Georgia, Florida, and Mississippi. In the northern states sporadic cases occur, usually in persons coming from the south, the West Indies, or Italy, occasionally also in natives. In the Ebers papyrus a disease is mentioned under the title of the AAA disease which corresponds closely with uncinariasis; this may, therefore, be looked upon as the oldest disease of which we have any written record.

Uncinariasis is due to a nematode worm, the Uncinaria duodenalis or hookworm. The disease in Europe is produced by a species slightly different from that causing uncinariasis in the new world. The old-world worm is the Uncinaria europeanea, the new-world worm the Uncinaria americana or Necator americanus. The disease is most prevalent in rural districts where the hygienic conditions are bad; also in coal and tin mines (in Cornwall, Germany, etc.), and in brick and tile works; indeed, in all places where moisture and warmth combined with filthy habits of defecation (soil pollution) favor the propagation of the parasites.

Infection was formerly believed to take place solely by way of the mouth, but Looss[2] has proved that it occurs mainly through the entrance of larvæ through the skin. The eggs cannot transmit the disease, the infection in man being invariably brought about by the larvæ. Drying very promptly kills the latter, but under favorable conditions of moisture they may survive seven months, if not more.

[1] Synonyms, Ankylostomiasis, dochmiasis, hookworm disease, Egyptian chlorosis, tropical chlorosis, cachéxie Africaine, rihagan (the yellows), brick-maker's anemia, miner's anemia, miner's cachexia, dirt-eating, negro consumption, mal d'éstomac, malnutrition, pica, opilacao, anemia of Ceylon, anémie des pays chauds, hypernia intertropicalis, geophagia, allotriophagia, mal-de-coeur, tunnel anemia, lazy sickness.

[2] Cent. f. Bakt., Parasit., and Infektionsk., 1903, 1904; Congrès de Zoologie de Berne, 1904; Zeit. f. klin. Med., 1905, 1906, lviii, 41; see also Manson, Lectures on Tropical Diseases, 1905.

In tropical countries the laborers usually walk barefooted over the ground, which often teems with uncinaria larvæ on account of the well-nigh universal practice of depositing the dejecta directly on the ground surface. The entrance of the larvæ through the skin, usually that of the feet and legs, is followed by a skin eruption known as ground itch, dew itch, coolie itch, water pox, water sores, mazamorra, or panighao. From the skin the larvæ are carried with the blood-stream to the heart and thence to the lungs. From the lungs they pass by way of the bronchi and trachea to the esophagus, and are then swallowed and carried to their final habitat—the upper part of the small intestine. They feed on the intestinal epithelium and suck blood when by chance they open a vessel. Smith and Loeb[1] have shown that the anterior extremity contains a coagulation-inhibiting substance, through the action of which the bleeding is caused to persist. It is more than probable that the worm also produces a hemolytic toxin. The chief symptom of uncinariasis is a profound anemia, of the type of pernicious anemia, with its accompaniments of lack of energy and great physical prostration ("lazy" disease). The disease occurs chiefly in early life, in persons between five and twenty-seven years.[2]

Uncinariasis has become, from the social and industrial standpoint, one of the most important diseases, the full significance of which has been made known to us through the splendid work of Stiles and the Porto Rican Commission. The recently organized Rockefeller Commission for the Study of the Hookworm Disease will, it may be hoped, contribute much to the solving of the problem. An idea of the serious nature of uncinariasis can be formed from the statement of the Porto Rican Commission[3] that in 1899 90 per cent. of the peasant population of Porto Rico was infested. It is estimated that in the United States 2,000,000 persons have the disease.[4]

Diagnosis.—Anemia and prostration in young persons should arouse the suspicion of uncinaria infection. Examination of the feces shows the segmented ova as well as the living worms.[5]

Prophylaxis.—In countries where the disease is endemic its frequency can only be lessened by an active campaign of sanitation and education—the people must be taught the dangers of soil pollution and the significance of ground-itch as the first sign of infection; they must wear shoes when working in damp soil—in Porto Rico when employed on coffee plantations, which are the most intensely infested regions; in mines, latrines must be provided, so as to abolish promiscuous defecation, and the miners must be urged to empty their bowels before entering the mines. In the mines of Busca and Formignano in Italy, in which 28.5 per cent. of the laborers suffered from uncinariasis, the disease was eradicated by flooding the mines with a 2 per cent. solution of formalde-

[1] Cent. f. Bakter., Parasitol. u. Infektionsk., 1905, 1906, xl, 738.
[2] C. A. Wells, Jour. Amer. Med. Assoc., June 4, 1910.
[3] Ashford, Jour. Amer. Med. Assoc., May 28, 1910.
[4] Lindeman, Jour. Amer. Med. Assoc., May 28, 1910.
[5] For special technic in examining feces for ova, see Bass, Arch. Inter. Med., 1909, iii, 446.

hyd.[1] The washing of hands and of fruit and vegetables that are eaten raw is important in districts where uncinariasis is endemic.

Another important factor in prophylaxis is the finding out and the treating of all infested cases. Mild forms of uncinariasis are often overlooked;[2] like typhoid carriers, they may give rise to severe forms of the disease in others.

Treatment.—The most efficient remedy is thymol, a crystalline principle obtained from thyme (Thymus vulgaris) and similar plants. Thymol is soluble in alcohol, chloroform, glacial acetic acid, fixed oils, and fats; in water only a slight degree (1:1100). Failure in treatment by thymol is usually due to improper modes of administration. The following is the method proposed by Lindeman.[3]

The patient should have nothing to eat from noon of the day previous to the administration day of the thymol. On this day and the day following, fat of any kind, milk, bacon, cream, butter, etc., should be avoided. Whisky, beer, wine, and oils are absolutely interdicted, as they all dissolve thymol. Early in the evening of the first day sufficient epsom salts should be given for efficient purgation. It is important that the bowels should be well moved. Early the next day the dose of thymol decided on should be divided into two parts and given one hour apart. It is best administered in cachets triturated with equal parts of milk-sugar; before using, the cachets should be well softened in water until they are of the consistency of a raw oyster. It is best to put the patient to bed on his right side. The thymol should be retained for from two to five hours, unless distress or symptoms of intoxication occur. Epsom salts should then be used for flushing the bowels and expelling the drug. The following dosage, worked out under the auspices of the State Board of Health of Florida, may be considered safe:

Under 5 years of age	Up to 8 grains.
5 to 10 " " "	8 to 15 "
10 to 15 " " "	15 to 30 "
15 to 20 " " "	30 to 45 "
20 to 60 " " "	45 to 60 "
Over 60 " " "	45 "

In Porto Rico the following treatment is in vogue: A dose of sodium sulphate or Glauber salts, from 20 to 40 grams (5 to 10 drams), is administered to the patient the night preceding the day on which the anthelmintic is to be taken. At six o'clock of the following morning half the dose of thymol—1.0 to 1.5 (15–22½ grains)—is given in gelatin capsule, and two hours later a similar dose. This is followed in two hours by 30 grams (1 ounce) of sodium sulphate.

In many cases it is necessary to repeat the anthelmintic treatment, and in some full recovery is never attained.

Complete cure was achieved in Porto Rico in 25.7 per cent. of the cases, and a practical cure in 17.38 per cent. more, making a total of

[1] Zeit. f. Gewerbhygiene, 1909, 327.
[2] Bass, Arch. Inter. Med., 1909, iii, 446.
[3] Jour. Amer. Med. Assoc., May 28, 1910.

43.08 per cent. It has been shown that the uncinaria may live in the intestines as long as twelve years. (Wells, *loc. cit.*)

Failure in treatment may be due to the presence of mucus in inordinate quantities on the intestinal wall. That, at any rate, seemed to be the most reasonable explanation in a fatal case of uncinariasis in which I made the autopsy. The intestine was covered with a thick layer of tough mucus, in which the worms were safely protected against the anthelmintic. In such cases cure can be achieved only by a preliminary removal of the mucus; and for this purpose ammonium chlorid, as suggested by Ringer, may be given.

Instead of thymol, betanaphtol has been employed in doses of 4 grains (0.25), but it does not compare in efficiency with the former.

The following instructions, issued by the Porto Rican Commission to the natives of the Island,[1] are worthy of reproduction here:

PORTO RICO ANEMIA COMMISSION.

INSTRUCTIONS TO THE FARM-OWNERS CONCERNING THE SUPPRESSION OF ANEMIA IN PORTO RICO.

Anemia is the disease from which the majority of our country folks suffer.

It alone causes more deaths in the Island than all other diseases.

Those peons and others that you are sheltering and that work for you are not strong men, because they are anemic.

Should they become cured they would be better workmen.

Send them to us that we may cure and teach them to prevent the disease.

To prevent anemia, remember that it comes from ground-itch (mazamorra): That ground-itch (mazamorra) is only contracted where there has been earth soiling; that to avoid ground-itch it is well to use shoes.

So advise your people.

But it is still more important that each house have its privy, and that no one defecate on the surface of the ground.

Prohibit your peons from defecating while at work on the plantation, unless they cover each stool with a little earth that may be scraped up with a cutlass (machete).

Thus the excrement is covered, and the worms killed.

ANEMIA COMMISSION OF PORTO RICO.

MANNER OF TAKING MEDICINES.

Take one of the two purgatives given to you to-night.

Take at six o'clock to-morrow morning half of the capsules.

Take the other half at eight o'clock the same morning.

Take a purgative at ten o'clock.

You should neither drink wine nor any alcoholic liquor during the time you are taking these medicines.

Come for more medicines, until the physician says you are cured.

Have a privy in your house. Do not defecate on the surface of the ground, but in the privy.

Do not walk barefooted, so that you may avoid contracting mazamorra in your feet. Wear shoes, and you will never suffer from anemia.

[1] Anemia in Porto Rico, 1906, 1907.

The anthelmintic treatment of uncinariasis should be accompanied or followed by the usual measures for the relief of anemia. In severe cases arsenic should be given hypodermically. Fresh air and sunshine are valuable aids in the treatment.

STRONGYLOIDOSIS

Strongyloidosis is infection with a nematode worm, the Strongyloides intestinalis (Strongyloides stercoralis; Anguillula intestinalis). It causes dyspeptic symptoms and a diarrhea which, at first mild, in subequent attacks becomes dysenteric in character. No parasite is believed to be the cause of the diarrhea prevailing in Cochin China. A few instances have been reported in the United States.[1] The parasite passes through an interesting developmental cycle, which is fully described by Braun[2] and Stiles.[3] Infection takes place through the skin.

The **diagnosis** is made by finding the larval form (Strongyloides stercoralis) in the feces. Eggs are very rarely seen.

The **treatment** is not very satisfactory. Thymol in repeated doses of 15 to 30 grains (1–2) is the usual remedy. Preti[4] has had success with glycerin, the patient receiving 50 grams of pure glycerin by the mouth (half of it in capsules) and 30 grams by the rectum two hours later. After two days the same procedure is repeated.

FILARIASIS

The Filariidæ are a large family of nematode worms occurring chiefly in tropical countries. Numerous species have been found parasitic in man; only the most important can be considered here.

Filaria Bancrofti

The mature Filaria bancrofti (Filaria nocturna; Filaria sanguinis hominis) inhabits the lymph-spaces, especially of the scrotum, vulva, and lower extremities, causing in those parts the well-known affection, elephantiasis. It may produce inflammation of the genito-urinary tract, with chyluria and hematuria; chylous ascites may also be caused by it. The sexually mature filariæ are viviparous, and the larvæ quickly pass from the lymph-stream into the blood. The disease is transmitted by mosquitos (culex, anopheles). Formerly it was believed that the infected mosquitos did not transmit it directly, but that the filarial larvæ became liberated on the death of the insect and were then ingested with the drinking-water, but recent studies have shown that infection is through the sting of living mosquitos harboring the larvæ.

Elephantiasis and hematochyluria are common in tropical countries; sporadic cases are met with in the southern part of the United States, and occasionally in the large cities of the north.

[1] Robert P. Strong, Johns Hopkins Hospital Reports, vol. x, and W. S. Thayer, Jour. Experimental Med., vi, 1901–1905, 75.

[2] Die tierischen Parasiten des Menschen, fourth edition, 1908, 288.

[3] Osler's System, vol. i.

[4] Therapeutische Monatshefte, xxiv, No. 2.

The *diagnosis* is readily made by finding the very actively motile larvæ in the peripheral blood, especially at night-time.

Prophylaxis is accomplished by taking the usual precautions against mosquitos. The principles of the antimalarial campaign are, as far as the mosquitos are concerned, also applicable to the filariasis problem.

Treatment.—*Hematochyluria.*—Drugs are of very little value in the treatment of filarial hematochyluria. The disease lasts many years with intermissions. Methylene-blue (1 grain several times a day), sandalwood oil, and ichthyol have been used with but an indifferent result. Wherry and McDill[1] have employed the *x*-ray after thorough cinchonization of the patient; the same treatment was used with fair success by Wellman and Adelung.[2] The latter gave enormous quantities of quinin; the first day, 15 grains, the second day, 60 grains, the third day, 70 grains, the next day, 70 grains, then 60, 50, 60, 30, 50, 50, 50, 30, then for five days 15 grains daily. The quinin was administered in 5-grain capsules, usually one or two at a dose. Five *x*-ray treatments were given, two before the quinin was started and three after its administration had been begun. The duration of the exposures was one minute, forty-five seconds, thirty seconds. Under the treatment the hematuria ceased, and the embryos greatly diminished in the circulating blood, but did not entirely disappear.

Elephantiasis.—In acute attacks rest and sedative lotions are indicated. Castellani[3] injects daily for a period of three or four months, with occasional intermissions, from 2 to 4 c.c. of fibrolysin (thiosinamin) into the gluteal muscles and wraps the leg firmly with flannel bandages. The redundant skin remaining after the absorption of the connective tissue is eventually resected. Several other methods of surgical treatment have been recommended, such as multiple incisions, ligation of the main artery of the limb, resection of the elephantiasic portions, and amputation.[4]

Dracontiasis

Dracontiasis is the disease caused by the Filaria medinensis (Dracunculus medinensis, or guinea-worm). It prevails in India, Arabia, and Africa, and may affect the European visitor of these regions. The guinea-worm, only the female of which is known, burrows in the connective tissue between the muscles or just under the skin of the lower extremity; rarely, in other parts of the body. When the embryos are ready for independent life, a vesicle appears over the future point of exit, and through this the worm discharges its young. After expulsion, which usually requires from two to three weeks, the worm dies, and is either expelled spontaneously or, as is the custom among the natives, is pulled out bit by bit. The embryos find their intermediate host in a fresh-water cyclops, which may enter the body with the drinking-water,

[1] Jour. Infect. Dis., June 24, 1905, 412.
[2] Jour. Amer. Med. Assoc., April 23, 1910.
[3] Brit. Med. Jour., October 21, 1908.
[4] See in this connection Dr. Enrique Nunes, La Cirurgia de las Manifestaciones Filariosicas, Habana, 1905.

or may introduce the worm through the skin while the individual is wading or bathing in contaminated waters. Manson[1] thinks that, in addition to the cyclops, another intermediate host may be necessary.

Diagnosis.—The diagnosis is not difficult, as the cord-like outline of the worm can be easily traced under the skin by palpation. This, however, is rarely possible before the vesicle has appeared. At the bottom of the ulcer resulting from the bursting of the vesicle the whitish head of the worm can be seen.

Prophylaxis.—Prophylaxis consists in filtering or boiling the drinking-water and in not wading or bathing in streams that may be contaminated.

Treatment.—Nearly all writers strongly advise against making traction upon the worm; for if the worm breaks, the portion remaining recedes into the deeper tissues and sets up a destructive inflammation. The worm may be cut out *in toto* while alive; or it may first be killed by injecting through its mouth, with a hypodermic syringe, a little of a 1:1000 solution of mercuric chlorid. After a day or two it can then be wound on a stick. Roth[2] lays open the burrow with a scalpel carried along a grooved, blunt-pointed probe, and then applies long strips of lint soaked in phenol lotion, covering this with oil-silk and wool and a tight bandage. The dressing is changed every twenty-four hours. After the third or fourth dressing the worm in every case comes away.

Filaria Loa

Filaria loa (Filaria diurna) is a common parasite on the west coast of Africa. Imported cases may be found in other countries. The worm occupies the connective tissues, especially the conjunctiva, and is probably transmitted by a dipterous insect. The **treatment** consists in removal of the parasite under local anesthesia.

MYIASIS

The larvæ and grubs of various species of dipterous insects of the order of Brachycera, or flies, may be parasitic in man. Such parasitism is called myiasis.[3] The larvæ are found on the skin, usually in ulcers, or on contiguous mucous membranes (myiasis externa or myiasis dermatosa); or in the intestinal canal, appearing in the feces or vomitus (myiasis interna or myiasis intestinalis). The fly most frequently concerned in myiasis is Lucilia macellaria (Compsomyia macellaria, the screw-worm). This deposits its eggs in the nose, especially in persons suffering from chronic catarrh, in the auditory canal, and in ulcers of the skin. It may enter the nasal sinuses and lead to serious infection—even to brain abscess.

Diagnosis.—The condition may be suspected if there is pain, head-

[1] Manson, Lectures on Tropical Diseases, 1905. [2] Roth, Lancet, 1894, i, 801.

[3] References: Nicholson, Jour. Amer. Med. Assoc., May 21, 1909; McCampbell and Corper, ibid., October 9, 1909; Swan, Jour. Tropical Medicine and Hygiene, January 1, 1910; Splendore, Arch. de parasit., 1904, 1905, ix; Chevrel, ibid., 1909, xii, 369.

ache, vertigo, sneezing, and an offensive mucoid or sanguineous discharge from the nose. The larvæ, after living from five to seven days in their first habitat, appear upon the surface to pupate.

Prophylaxis.—Persons with superficial ulcers or nasal catarrh should not sleep out-of-doors or in open rooms during the sunny hours of the day, as it is then that the flies deposit their eggs.

Treatment.—The treatment consists in using sprays or inhalations of chloroform or solutions of camphor and phenol to kill the larvæ. Afterward they may be removed with the forceps. Other measures and remedies employed are balsam of Peru, sodium salicylate, thymol in the form of nasal douches, salt solution, and insufflations of calomel.

Various other flies may deposit their eggs in accessible cavities or upon ulcers in human beings, viz., Musca domestica, Cephalomyia ovis, gastrophilus, etc.

Glossina palpalis, the tse-tse fly, the carrier of the Trypanosoma gambiense, the cause of sleeping-sickness; glossina is also the intermediate host of Trypanosoma cazalboui, the cause of souma, an epizootic of the equine family in Africa.[1] Ordinary houseflies transmit typhoid fever and perhaps other infections.

GASTROPHILUS

The larva of a botfly or œstrus of the genus gastrophilus is supposed to cause the so-called *creeping eruption* (larva migrans) of dermatologists. Only one parasite is present as a rule. The condition is most common in southern Russia, but a few cases have been observed in this country.

The treatment consists in excising or cauterizing an area around or just beyond the borders of the eruption. Stelwagon[2] has used mercuric chlorid, 2 grains to the ounce, cataphoretically, combined with the application of a minute quantity of nitric acid applied to the suspected seat of the parasite. He also advocates the use of the high-frequency current.

ACARIASIS

Acariasis is infection with mites and ticks (acarines). *Harvest-mites* are the larvæ of several species of Leptus (Leptus americanus, Leptus irritans, Leptus autumnalis), belonging to the genus Trombidium. In the vernacular, Leptus americanus is known as the harvest-bug, red-bug, or jigger, and the disease caused by it as chiggers. During the summer months, especially during July and August, the larvæ burrow into the skin to suck blood, causing an urticarial or erythematous, itching eruption, which may be accompanied by considerable constitutional disturbance. After a few days the symptoms disappear.

Treatment.—The condition usually yields quickly to a warm bath; if not, to applications of alcohol, ammonia, or carbolized vaselin. If the insect can be discovered, it should be extracted with a fine needle.

[1] Bouffard, Ann. de l'Institut. Pasteur, April, 1910.
[2] Diseases of the Skin, p. 1095.

GRAIN-ITCH; STRAW-ITCH

Persons handling grain or straw are often attacked by a transitory, eruptive, itching skin affection, which is due to a small arthropod, the Pediculoides ventricosus. Recently there have occurred in various sections of this country—Pennsylvania, New Jersey, Ohio, Indiana—endemic outbreaks of an urticarial skin-eruption of great severity, which Goldberger and Schamberg have traced to the same parasite. The disease has been called grain-itch, urticarioid dermatitis, dermatitis ditropenotus aureoviridis, straw-itch, acarodermatitis urticarioides, Schamberg's disease, and straw-mattress disease (in Philadelphia). Pediculoides ventricosus lives upon other insects feeding on grain, such as the Angumois grain-moth (Sitotraga cerealella), and Isosoma tritici (joint-worm), and cannot survive the death or disappearance of its hosts.

Diagnosis.—A history of contact with grain or straw or the use of a new straw mattress suggests the diagnosis. The eruption is characteristic.[1] Scrapings from the lesions, when examined under a low power of the microscope, may show the presence of the mite; but as the latter does not burrow and may be brushed off by the friction of the clothing, the examination of scrapings is often negative.[2]

Prophylaxis.—Starvation kills the parasite, and may be accomplished by storing the straw or grain at summer temperature, or by sunning or airing it during the summer weather. In this way rapid multiplication and escape of the insects on which it preys are promoted. The exhaustion of its food-supply leads to the death of the mite. These measures, of course, do not guard the farmer and farm-laborer engaged in harvesting the grain. Goldberger[3] believes that they may protect themselves by anointing the body with some bland oil or grease, following this by a change of clothing and a bath as soon as their work is done. In wheat thrashed as promptly as possible after harvest and directly from the shocks in the field, the grain-moth, without which there are no mites, practically does not occur. The following is from Webster's interesting pamphlet:[4]

"A careful study of a large number of wheat fields in central Ohio by the Bureau of Entomology has shown that the infestation from the joint-worm during the season of 1909 varied from 1 to 95 per cent. Here, too, the mite was found generally in the cells in the straw occupied by the joint-worm larvæ. It has been found that in central Ohio, September-sown wheat is much more seriously affected by the joint-worm than that sown in October; and also that the infestation is worse in both cases on poor soil than in that of an average degree of fertility, and still less on good soil. The infestation is invariably worse in fields in which wheat has been grown the previous year, and in fields lying adjacent thereto. Fall-plowed fields showed the least infestation of all. It appears, therefore, that moderately late-sown wheat on good soil,

[1] See Schamberg, Jour. of Cutaneous Diseases, February, 1910.
[2] Goldberger, Public Health Reports, 1910, xxv, No. 23.
[3] Goldberger, loc. cit.
[4] Webster, Bureau of Entomology, Circular No. 118.

and on land not devoted to wheat the previous year, nor lying adjacent to such fields, escapes with the least injury; and that less difficulty with the dermatitis is experienced where wheat is thrashed from the field, and as soon as possible after the grain is harvested. As the joint-worm winters over in the stubble, where this can be burned during fall, winter, or spring, the destruction of both the pest and the mite in the field will be complete. Where this cannot be done, much good may be accomplished by raking over last year's stubble fields in the spring, and burning the stubble thus collected. So important are these measures that practising physicians might almost include them with their prescriptions for this painful skin disorder."

Treatment.—Schamberg found a warm bath and the use of soap efficacious. The following ointment not only destroys the mites, but also relieves the local symptoms:

℞. Betanaphtol ..... gr. xxx (2.0);
Precipitated sulphur ..... gr. xl (2.7);
Benzoinated lard ..... ℥j (30.0).

LINGUATULA

Linguatula rhinaria (the tongue-worm, in reality an arthropod) and its larva, Pentastomum denticulatum, are found parasitic in man.

The former usually lives in the frontal, nasal, and maxillary sinuses of the dog, sheep, horse, wolf, and goat, and causes severe inflammation of the mucous membrane.

The eggs are discharged with the mucus and pass into other animals or through contamination of food into man. The embryos wander through the gastric or intestinal wall or along the blood and lymph-vessels to various organs and become encapsulated. After six or seven months the embryo is transformed into the larva (Pentastomum denticulatum), which perforates the capsule and tries to pass out of the body, getting in its journey into the peritoneal or pleural cavity, into the intestine or bronchi, and thence outside. Pentastomum has been found most often in the liver and intestine.[1]

Treatment.—No definite treatment is known and probably, as far as the larvæ are concerned, none is required.

NEMATOCERA (MOSQUITOS)

Mosquitos are a universal pest. Only the female sucks blood. Its sting causes a small or a large red wheal, which itches intensely. In addition to the poison, several species, with their sting, also introduce the germs of serious parasitic diseases: malaria is conveyed by Anopheles; yellow fever, by Stegomyia calopus; filariasis, by various species of Culex and Anopheles.

Prophylaxis.—The very best protection against mosquitos is to abolish their breeding-places.[2] All pools should be filled, and all recep-

[1] See Laengner, Cent. f. Parasit. u. Infektionsk., 1905, 1906, xl, orig., 368.
[2] Howard, Osler's System, vol. iii, p. 389.

tacles in which water might collect should be removed; as Howard says, "tin cans and old bottles, in the rainy summer, may hold sufficient water for hundreds of mosquitos." Rain-water barrels and tanks should be carefully screened. Salt marshes and inland swamps should be drained, as has been successfully done in the case of the Potomac marshes near Washington, and by Dr. John T. Smith in parts of New Jersey. Pools and ponds, if they cannot be kept drained, should be sprayed with kerosene or light fuel oil.

The windows and doors of all houses should be screened in sections where mosquitos prevail. Various pungent oils may also be used to keep off the insects. Wolfendale[1] recommends phenol solution, 1 in 60 or 1 in 40, or eucalyptol, ʒj to glycerin or olive oil, fʒij (4–64).

Treatment.—Mosquito-bites should not be scratched, as that increases the irritation, and may, in some instances, lead to septic infection. To allay itching, I have found water of ammonia most useful.

IXODIASIS

Infestation with ixodes or ticks is ordinarily not of much moment in this country. The female burrowing into the skin to suck blood may cause considerable pain. As disease-carriers, ticks are of much importance—Dermacentor occidentalis is believed to convey Rocky Mountain spotted fever, while Boöphilus annulatus is concerned in the transmission of Texas fever of cattle.

Treatment.—Ticks should not be pulled out, for when that is done the head is left behind and causes inflammation. By covering the ticks with oil, petrolatum, or turpentine, their breathing-pores are closed; this causes the insects to loosen their hold.

SCABIES (ITCH)

Scabies, or itch, is due to Sarcoptes scabiei, which burrows under the skin, especially of the penis, of the breast, between the fingers and at the flexures of the knee, elbow, and groin, causing an intense itching. Various related species live on the lower animals and may be transferred to man. The disease is conveyed by contact and through fomites.

Diagnosis.—The diagnosis is readily made by the character and location of the lesions and the presence of burrows, or galleries, with the female itch-mite at the end.

Prophylaxis.—The patient's underclothing and the bedding should be boiled, and the outer garments either baked or ironed with a very hot iron. As the disease is readily transmitted, the other members of the family should be examined.

Treatment.—The treatment consists in the use of preparations known as parasiticides, of which the best are sulphur, balsam of Peru, and beta-naphtol. As an indispensable preliminary, the patient should take a bath, using ordinary soap or tincture of green soap freely, and a coarse-meshed cloth. The remedy is then applied, usually night and morning,

[1] Journal of Tropical Medicine and Hygiene, May, 1910.

for two or three days, the underclothing not being changed during that time. Sulphur is employed in ointments of the strength of 1 to 1½ drams (4–6) to the ounce (30.) of lard or petrolatum. Balsam of Peru is applied with a brush and left on over night. Betanaphtol is used in a strength of 15 to 30 grains (1–2) to the ounce of petrolatum.

PEDICULOSIS

This appears under three forms: Pediculosis capitis, caused by the Pediculus humanis; Pediculosis corporis, due to the Pediculus corporis, or Pediculus vestimenti; and Pediculosis pubis, caused by the crab louse (Phthirius pubis). The disease is conveyed directly from man to man and also through clothing and bedding. If the researches of Nicolle[1] are substantiated, the louse possesses great epidemiologic importance. Nicolle has shown experimentally that Pediculosis corporis can transmit typhus.

Diagnosis.—The diagnosis of Pediculosis capitis is made by finding either the living parasites or the nits on the hair-shafts.

Treatment.—In the case of Pediculosis capitis, if the patient is a man, the hair should be cut. The parasites are killed by washing the head with a 2 per cent. phenol solution or with tincture of Cocculus indicus; or by saturating the hair with kerosene. In addition, the hair should be combed with a fine-tooth comb.

The **diagnosis** of Pediculosis corporis is made by finding the parasites in the underclothing and by the characteristic scratch-marks and secondary lesions.

Treatment.—The affection is cured by a bath and putting on fresh clothes, the old ones being carefully cleaned or, preferably, baked or boiled.

The **diagnosis** of Pediculosis pubis is made by finding the parasite or the nits on the pubic hairs.

Treatment.—The best remedy is mercurial ointment.

FLEAS

The flea (Pulex irritans) is a wide-spread human pest. Usually, it merely stings; but in very filthy persons it may deposit eggs in the skin, which hatch into larvæ and pupæ.

Cleanliness is the remedy.

Sarcopsylla Penetrans.—The Sarcopsylla penetrans (Pulex penetrans, chigoe, chigger, sand flea) is related to the ordinary flea, but lives chiefly in warm climates, where it constitutes a great nuisance. It burrows under the skin, causing pea-like swellings, which may break down into pustules and abscesses. The female alone attacks man. The lesion is usually found about the toes, at the side of or under the nail; also at the knee and in the scrotum.

Diagnosis.—The diagnosis is made by finding the characteristic pea-

[1] Ann. de l'Institut Pasteur, April, 1910.

like swellings under the nails and between the toes; and, on close inspection, by seeing the caudal extremity of the parasite.

Prophylaxis.—The wearing of shoes and the use of essential oils are means of protection against the sand flea.

The *treatment* consists in the removal of the parasite with a blunt needle, and the application of mild lotions or ointments (boric acid) to relieve the irritation.

THE BEDBUG

The bedbug, Acanthia lectularia (Cimex lectularius), is an unpleasant parasite living in beds, cracks in the floor, behind wall-paper, and on picture frames. It may often be seen crawling on clothing; seldom actually on the body surface. Its sting produces a large, itching wheal, and usually makes sleep at night impossible. The Mexican bedbug seems to be concerned in the spread of Mexican typhus fever. All species exhale a peculiarly disagreeable odor. The insects are carried by human beings and in clothing, especially in laundry done in the homes of washerwomen.[1]

Treatment.—At times it is impossible to rid an apartment or house of bedbugs, the insects seeming to defy all the traps that the ingenuity of man can lay for them. Stiles recommends fumigating with flowers of sulphur, two pounds to one thousand cubic feet of space; but even this does not annihilate them; formaldehyd likewise often fails. The bedstead and floor should be washed with mercuric chlorid solution, and the bedding should be destroyed, but even if no bugs are seen for several days or weeks, the occupant of the apartment should not cease looking for them in their accustomed haunts, as they may suddenly reappear.

DEMODEX FOLLICULORUM

Demodex folliculorum is a minute, elongated parasite, occupying the sebaceous glands and hair-follicles of the nose, forehead, and cheeks. There is some doubt whether the parasite possesses any pathogenic properties, although some dermatologists attribute to it a peculiar circumscribed, light-brown pigmentation of the face.

Treatment.—The treatment consists in the removal of the mite and the subsequent application of soft soap or alcohol.

[1] Stiles, loc. cit.

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